Building Digital Video Games at School: A Design-Based Study of Teachers’ Design of Instruction and Learning Tasks to Promote Student Intellectual Engagement, Deep Learning and Development of 21st Century Competencies

Lambert, Deborah


http://hdl.handle.net/11023/2742
doctoral thesis

University of Calgary graduate students retain copyright ownership and moral rights for their thesis. You may use this material in any way that is permitted by the Copyright Act or through licensing that has been assigned to the document. For uses that are not allowable under copyright legislation or licensing, you are required to seek permission.

Downloaded from PRISM: https://prism.ucalgary.ca
Building Digital Video Games at School: A Design-Based Study of Teachers’ Design of Instruction and Learning Tasks to Promote Student Intellectual Engagement, Deep Learning and Development of 21st Century Competencies

by

Deborah Gail Lambert

A THESIS
SUBMITTED TO THE FACULTY OF GRADUATE STUDIES
IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE
DEGREE OF DOCTOR OF PHILOSOPHY

GRADUATE PROGRAM IN EDUCATIONAL RESEARCH

CALGARY, ALBERTA

JANUARY, 2016

© Deborah Gail Lambert 2016
Abstract

With the continuous impact of advancing technologies on learning environments and today’s students, one of the challenges faced by K-12 educators in some Canadian schools is to find innovative pedagogies to intellectually engage students in deep learning of curriculum content and to promote the development and use of 21st century competencies. In an attempt to address this challenge, an intervention, the design and building of digital video games, was collaboratively implemented and explored by a research design team—the researcher, two grade 6 teachers, their students (100) and a professional development leader at a charter school in Calgary, Alberta. This intervention taps into the interest that many students already have in video games and tends to support the learning styles of today’s students.

Employing one macro-cycle of the design-based research process, this intervention was adopted into the educational context, explored through the implementation of three learning tasks: game concept development, storyboarding and programming, and assessed as a potential innovative pedagogy to address the problem. This study was guided by two research questions, which focused on: (1) the ways in which teachers’ design of instruction and learning tasks need to shift to implement the intervention; and (2) the impact of the intervention on students’ intellectual engagement, deep learning of curriculum content and the development and use of 21st century competencies.

Findings revealed that (1) teachers needed to employ more interaction modes to collaborate and communicate during these tasks; use extensive coaching and scaffolding; continuously use various forms of assessments with feedback loops to assess students’ progress; and use extensive conceptual and divergent thinking; and (2) as students/groups participated in these tasks’ activities, the storyboarding task seemed to represent the area of deepest learning of
the curriculum content and highest intellectual engagement, and students seemed to become more proficient in all the 21\textsuperscript{st} century competencies.

An assessment of the findings also revealed that the intervention qualifies as a potential and developing effective innovative pedagogy for deep learning, and that findings are significant for informing K-12 educators, school jurisdictions and Alberta Education on the impact and implications of game design-based learning, in school.

\textbf{Keywords:} deep learning, intellectual engagement, 21\textsuperscript{st} century competencies, digital video games, design-based research, macro-cycle
Acknowledgements

First and foremost, I give thanks to my Father, God, who lovingly provided me with the strength and ability to endure and complete this journey. He has shown me that anything is possible with him.

I deeply express my appreciation to my dedicated co-participants in this research, the grade 6 teachers, Matt, Dave and Thomas (pseudonyms), their wonderful and enthusiastic students and the principal and staff of the charter school, in helping to make this research and dissertation a reality. The teachers’ and students’ interest, openness and willingness to collaborate with me in exploring this intervention and sharing their experiences helped to provide a substantive amount of significant information that will most certainly and positively impact the game design and building research base.

I cannot extend enough gratitude to my supervisor and mentor, Dr. Michele Jacobsen, for her genuine patience, guidance and continuous support throughout this journey. Her close reading of this work with her timely and constructive feedback proved invaluable in shaping my thinking, understanding and writing. I am also extremely grateful to Dr. Sharon Friesen and Dr. Beaumie Kim for their much needed critical feedback and advice in the continuous improvement of this work. I also appreciate the invaluable perspectives and contributions made by my fellow students and professional colleagues, which provided new lenses for understanding this ambitious work of art.

On a more personal level, I wish to thank my husband, Anthony, and daughter, Naadia, for their patience and encouragement, which were so critical to sustaining this long, demanding journey. Their support and confidence in my abilities are truly appreciated.
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABSTRACT</td>
<td>ii</td>
</tr>
<tr>
<td>ACKNOWLEDGEMENTS</td>
<td>iv</td>
</tr>
<tr>
<td>LIST OF TABLES</td>
<td>xi</td>
</tr>
<tr>
<td>LIST OF FIGURES</td>
<td>xiii</td>
</tr>
<tr>
<td>CHAPTER 1: INTRODUCTION AND BACKGROUND TO THE RESEARCH</td>
<td>1</td>
</tr>
<tr>
<td>Educational Technology Context for Research</td>
<td>1</td>
</tr>
<tr>
<td>Statement of the Problem</td>
<td>3</td>
</tr>
<tr>
<td>The Intervention/Research-Informed Design Solution and Rationale</td>
<td>9</td>
</tr>
<tr>
<td>Purpose of the Research</td>
<td>12</td>
</tr>
<tr>
<td>Research Questions</td>
<td>13</td>
</tr>
<tr>
<td>Significance of the Research</td>
<td>13</td>
</tr>
<tr>
<td>Definition of Terms</td>
<td>15</td>
</tr>
<tr>
<td>Structural Layout of the Research</td>
<td>18</td>
</tr>
<tr>
<td>CHAPTER 2: A REVIEW OF THE LITERATURE</td>
<td>20</td>
</tr>
<tr>
<td>Introduction</td>
<td>20</td>
</tr>
<tr>
<td>Game Design-Based Learning Context</td>
<td>21</td>
</tr>
<tr>
<td>Overview</td>
<td>21</td>
</tr>
<tr>
<td>Game-Design Principles for Educational Contexts</td>
<td>23</td>
</tr>
<tr>
<td>Learning Theories Supporting Game Design-Based Learning</td>
<td>24</td>
</tr>
<tr>
<td>Situated Learning Theory</td>
<td>25</td>
</tr>
<tr>
<td>Situated Learning as a Model of Instruction</td>
<td>27</td>
</tr>
<tr>
<td>Constructivism</td>
<td>30</td>
</tr>
<tr>
<td>Constructionism</td>
<td>32</td>
</tr>
<tr>
<td>Informed Theoretical Framework for Proposed Intervention</td>
<td>33</td>
</tr>
<tr>
<td>Authentic Context</td>
<td>33</td>
</tr>
<tr>
<td>Authentic Activities</td>
<td>34</td>
</tr>
<tr>
<td>Access to Expert Performances and the Modeling of Processes</td>
<td>34</td>
</tr>
<tr>
<td>Multiple Roles and Perspectives</td>
<td>34</td>
</tr>
<tr>
<td>Collaborative Construction of Knowledge</td>
<td>35</td>
</tr>
<tr>
<td>Coaching and Scaffolding</td>
<td>35</td>
</tr>
<tr>
<td>Reflection</td>
<td>36</td>
</tr>
</tbody>
</table>
Articulation.................................................................................................................................37
Integrated Authentic Assessment ...............................................................................................37
Related Studies on the Design and Building of Digital Video Games in and Beyond the K-12 Classroom .........................................................................................................................38

CHAPTER 3: RESEARCH METHODOLOGY ...........................................................................47
Philosophical Position of Research Study ..................................................................................47
Epistemological Perspective ........................................................................................................47
Research Design ........................................................................................................................49
Research Approach .....................................................................................................................49
Description of the Research Context .........................................................................................51
   The charter school ..................................................................................................................51
   Physical context .....................................................................................................................54
   Scratch—game software .........................................................................................................56
   Actual time-tabled sessions ....................................................................................................59
   Participants .............................................................................................................................65
Procedures for Data Collection ................................................................................................74
   Quantitative methods ............................................................................................................78
   Qualitative methods .............................................................................................................78
Trustworthiness of Data Collected .............................................................................................83
Procedures for Analysis of the Data ..........................................................................................85
Ethical Considerations ...............................................................................................................90
Limitations of the Research Study .............................................................................................93

CHAPTER 4: IMPLEMENTATION OF THE INTERVENTION ...........................................96
Introduction .................................................................................................................................96
Preliminary Research Phase—Analysis and Exploration .............................................................97
Prototyping Phase—Design and Construction ........................................................................102
   Planning Task ......................................................................................................................104
   Learning Tasks ....................................................................................................................108
      Game concept development task ......................................................................................110
      Storyboarding task ..........................................................................................................124
      Programming task ...........................................................................................................133
Assessment Phase—Evaluation and Reflection .........................................................................140
CHAPTER 5: FINDINGS .................................................................................................................. 142

Introduction ............................................................................................................................... 142

Teacher Participants’ Shifts in Design of Instruction and Learning Tasks ...................... 143

Actual Shifts ............................................................................................................................... 148

A more complex interactive learning community network with multiple interaction modes for collaboration and communication .............. 149

More extensive use of coaching and scaffolding ................................................................. 159

Process/context-dependent assessments and feedback loops ............................................. 169

Conceptual thinking .................................................................................................................. 176

Divergent thinking .................................................................................................................... 177

Increased theoretical support for design of learning tasks’ activities ........... 178

Impact of the Design and Building of Digital Video Games on Students’ Deep Learning ................................................................. 181

Deep Learning in the Game Concept Development Task .............................................. 187

Possible evidence of deep learning of the chosen curriculum content in the game concept development task ................................................. 189

Deep Learning in the Storyboarding Task ........................................................................ 195

Possible evidence of deep learning of the chosen curriculum content in the storyboarding task ........................................................................... 197

Possible evidence of deep learning of role-specific skills and technologies in the storyboarding task ................................................................. 212

Possible evidence of deep learning of the game aspects or game design principles in the storyboarding task ......................................................... 214

Deep Learning in the Programming Task ........................................................................... 216

Possible evidence of deep learning of game aspects or game design principles and game software/Scratch in the programming task .......... 225

Conclusion on Deep Learning in all the Learning Tasks .................................................... 226

Impact of the Design and Building of Digital Video Games on Students’ Intellectual Engagement .............................................................................. 227

Interest ..................................................................................................................................... 230

Relevance ................................................................................................................................. 232

Motivation ............................................................................................................................... 234

Effort ....................................................................................................................................... 235

Flow ........................................................................................................................................ 238

Enjoyment ............................................................................................................................... 242
Impact of the Design and Building of Digital Video Games on Students’ Development and Use of 21st Century Competencies .......................................................... 245

Problem Solving ........................................................................................................ 249
Decision Making ......................................................................................................... 252
Creativity and Innovation ........................................................................................... 253
Critical Thinking ......................................................................................................... 254
Collaboration/Teamwork and Communication .......................................................... 254
Information Literacy .................................................................................................... 257
Living in the World ....................................................................................................... 257


CHAPTER 6: DISCUSSION OF FINDINGS ..................................................................... 261

Introduction ................................................................................................................... 261

The Design and Building of Digital Video Games as an Innovative Pedagogy ............ 262

New Learning Partnerships in the Design and Building of Digital Video Games .......................................................... 263

Relationships .............................................................................................................. 264
Feedback ..................................................................................................................... 270
Student aspirations ..................................................................................................... 271
Learning to learn .......................................................................................................... 271

Deep Learning Tasks in the Design and Building of Digital Video Games ............... 272

Learning tasks re-structured students’ learning of curriculum content ........... 273
Learning tasks provide real experiences in creating and using new knowledge ......................................................................................................................... 279
Development of key future skills/21st century competencies in learning tasks ................................................................................................................................. 284
Intellectual engagement in learning tasks ................................................................. 285

Access to Digital Tools and Resources/Technologies in the Design and Building of Digital Video Games ......................................................................................... 287

Comparison of Findings from Present and Past Research Studies on the Design and Building of Digital Video Games in and Beyond the School Context .......................................................... 290

Common Outcomes and Experiences in Past and Present Research Studies .......... 290
Unique Outcomes and Experiences in Present Research ......................................... 292
Addressing Concerns in Game Design-Based Research Outcomes ......................... 294
Curriculum content in game prototypes more extrinsically than intrinsically integrated ................................................................. 294

Students more interested in designing and building games rather than learning the curriculum content ........................................... 297

Assessment in the design and building of digital video games .......... 297

Scaffolding in video game design and building .................................. 298

Pedagogical usability and effectiveness in the school context .......... 299

Addressing/Narrowing Gaps in Game Design-Based Research ............ 301

Deep learning pedagogy ................................................................. 301

Innovative practice to support 21st century competencies ................. 302

Innovative practice and/or participatory learning environment for student intellectual engagement ............................................... 303

Assessment of, for and as learning in the context of video game design and building in school .................................................. 304

Game-making or video game design and building to foster deep collaboration ................................................................. 305

CHAPTER 7: CONCLUSIONS, IMPLICATIONS AND RECOMMENDATIONS ........ 308

Conclusions ................................................................................. 308

Implications ................................................................................. 311

Effective Teaching and Learning Practice with Potential to Make a Positive Difference ................................................................. 312

The Theoretical Support Needed for the Design and Building of Digital Video Games as a Pedagogical Design .................................. 314

Designing Pedagogical Frameworks/Models to Promote Deep Learning, Intellectual Engagement and Development of 21st Century Competencies .... 315

The Design and Implementation of Learning Tasks’ Activities as a Collaborative Knowledge-Building Model .................................. 316

The Design and Implementation of Learning Tasks’ Activities as a Participatory Learning Environment ........................................... 319

Emerging Design Principles for Learning Tasks’ Activities as a Responsive Pedagogy ................................................................. 320

Curriculum Re-design ................................................................. 322

Implementation of Technologies into Formal Classroom Teaching and Learning ................................................................. 325

Significant Contribution to the Knowledge and Research Base of Game Design-Based Learning .................................................. 326
List of Tables

Table 1: Twenty-First Century Competencies and Specific Skills......................... 374
Table 2: Game Design Principles................................................................. 24
Table 3: Game Design Principles: Specific Details of Embedded Educational Characteristics of Gaming, Learning and Technical Aspects......................... 376
Table 4: Time-Tabled Sessions for Planning Task............................................. 60
Table 5: Time-Tabled Sessions for Game Concept Development Task.................... 62
Table 6: Time-Tabled Sessions for Storyboarding Task...................................... 63
Table 7: Time-Tabled Sessions for Programming Task....................................... 64
Table 8: Data Collection Methods and Sources Matched to Research Questions........ 76
Table 10: Collaborative Framework by Teacher Participants and Researcher to Guide the Design and Implementation of the Intervention in the Prototyping Phase of the Design-Based Research Process......................... 450
Table 11: Instructional Activities Based on Classroom Teacher Observation Protocol for Teacher Performance and Behaviours........................................... 109
Table 12: Design Principles to Guide Learning Tasks’ Activities/Ideas.................... 109
Table 13: Distribution of Decision-making Methods and Models as Chosen by Groups .............................................................................................................. 112
Table 14: Comparison Between Students’/Groups’ Research Questions and Narrative/Storyline Ideas ......................................................................................... 118
Table 15: Excerpts of Teaching Moments Depicting Intrusive/Prescriptive Guidance and Support in Learning Tasks................................................................. 162
Table 16: Excerpts of Teaching Moments Depicting Intrusive/Nonprescriptive Guidance and Support in Learning Tasks............................................................ 164
Table 17: Excerpts of Teaching Moment and Discussion Depicting Nonintrusive/Prescriptive Guidance and Support in Learning Tasks......................... 166
Table 18: Excerpts of Discussion, Instructional Conversation and Socratic Dialogues/Questions Depicting Nonintrusive/Nonprescriptive Guidance and Support in Learning Tasks ................................................................. 168

Table 19: Examples of Game Concept Artifacts Created by Students/Groups in Google Documents ................................................................. 192

Table 20: Descriptive Storyboard for The Clan Mother .................................................. 207

Table 21: Descriptive Storyboard for Lost with Clues .................................................... 208

Table 22: Emerged Students’ Roles During Their Participation in Learning Tasks’ Activities ................................................................. 269

Table 23: Learning and Intervention Goals Based on Curriculum Content and Teachers’ and Students’ Aspirations .................................................... 274

Table 24: Specific Success Criteria to Indicate that Goals Are Being Achieved ...................... 275

Table 25: Knowledge-Building Principles in the Design and Implementation of Learning Tasks’ Activities ................................................................. 317
List of Figures

Figure 1: Conceptual Framework for the Impact of New Media and New Learners on K-12 Learning Environment .................................................................2

Figure 2: Screen Shot of Scratch Interface ................................................................56

Figure 3: Grade 6 Students’ Experience Playing Vs Building Video Games ..............69

Figure 4: Grade 6 Male Students’ Experience Playing Vs Building Video Games .......70

Figure 5: Grade 6 Female Students’ Experience Playing Vs Building Video Games ....70

Figure 6: Adapted Embedded Design from Creswell’s (2013) Mixed Methods Designs Employed to Collect the Data .........................................................75

Figure 7: Implementation of the Design and Building of Digital Video Games in Macro-Cycle of the Design-Based Research Process Adapted from Mckenney and Reeves’ (2012) Micro-, Meso- and Macro-Cycles in Educational Design Research .................................................................96

Figure 8: Lived Timeline for the Actual Exploration of the Intervention in the Prototyping Phase of the DBR process .........................................................102

Figure 9: Framework for the Actual Design, Implementation and Exploration of the Intervention in the Prototyping Phase of the DBR process .........................103

Figure 10: Initial Game Concept Development Plan ...............................................111

Figure 11: Formative Assessment/Reflection/Feedback/Refinement Within Game Concept Development Task .................................................................121

Figure 12: Initial Storyboarding Plan .....................................................................125

Figure 13: Formative Assessment/Reflection/Feedback/Refinement Within Storyboarding Task .................................................................126

Figure 14: Programming Plan ...............................................................................134

Figure 15: Peer Assessment/Reflection/Feedback/Test/Refinement Within Programming Task .................................................................136

Figure 16: Radar Graph Showing Evidence of Teachers’ Use of Instructional Activities During the Implementation of the Game Concept Development, Storyboarding and Programming Tasks 144
Figure 17: Bar Chart Showing Evidence of Teachers’ Use of Instructional Activities in the Game Concept Development Task According to Sessions.................................................................145

Figure 18: Bar Chart Showing Evidence of Teachers’ Use of Instructional Activities in Storyboarding Task According to Sessions.................................146

Figure 19: Bar Chart Showing Evidence of Teachers’ Use of Instructional Activities in Programming Task According to Sessions..................................................146

Figure 20: Radar Graph Showing Evidence of the Design Principles Guiding Activities/Ideas in the Game Concept Development, Storyboarding and Programming Tasks........................................................................................................147

Figure 21: Interaction Modes for Collaborating and Communicating During Learning Tasks, Adapted and Modified from Moore’s (1989) Three Types of Interactions in an Online Course.................................................................150

Figure 22: Coaching and Scaffolding Model During Implementation of Learning Tasks Adapted from Cates and Bruce’s (2000) Model of Scaffolding..................162

Figure 23: Forms of Assessments and Feedback Loops Used in the Teacher Participants’ Design of Instruction During Implementation of Learning Tasks............172

Figure 24: Radar Graph Showing Evidence of Student Deep Learning in the Game Concept Development, Storyboarding and Programming Tasks...........181

Figure 25: Bar Chart Showing Evidence of Student Deep Learning in the Game Concept Development Task According to Sessions.........................................182

Figure 26: Bar Chart Showing Evidence of Student Deep Learning in the Storyboarding Task According to Sessions.................................................................183

Figure 27: Bar Chart Showing Evidence of Student Deep Learning in the Programming Task According to Sessions.................................................................184

Figure 28: Visual Storyboard for *Lost with Clues*.................................................................209

Figure 29: Storyboard for *Athens Adventures*.................................................................210

Figure 30: Video Game Prototype 1 Scenes from *Journey to The Onondaga Clan*........219

Figure 31: Scripts for Scenes 1-6 in Journey to *The Onondaga Clan* Prototype 1.........220

Figure 32: Video Game Prototype 1 Scenes from *Ancient Athens Scratch Project*........221

Figure 33: Scripting for Scenes 1-6 (Among Others) in *Ancient Athens Scratch Project*...222
Figure 34: Video Game Prototype 1 Scenes from Athens Adventures……………………..224
Figure 35: Scripting for Scenes 1-5 and 11-14 in Athens Adventures Prototype 1…………224
Figure 36: Radar Graph Showing Evidence of Student Intellectual Engagement in the Game Concept Development, Storyboarding and Programming Tasks….228
Figure 37: Bar Chart Showing Evidence of Student Intellectual Engagement in Game Concept Development Task According to Sessions…………………………..228
Figure 38: Bar Chart Showing Evidence of Student Intellectual Engagement in Storyboarding Task According to Sessions………………………………………229
Figure 39: Bar Chart Showing Evidence of Student Intellectual Engagement in Programming Task According to Sessions………………………………………..229
Figure 40: Radar Graph Showing Evidence of 21st Century Competencies in the Game Concept Development, Storyboarding and Programming Tasks………...246
Figure 41: Bar Chart Showing Evidence of 21st Century Competencies in Game Concept Development Task According to Sessions…………………………….247
Figure 42: Bar Chart Showing Evidence of 21st Century Competencies in Storyboarding Task According to Sessions……………………………………………247
Figure 43: Bar Chart Showing Evidence of 21st Century Competencies in Programming Task According to Sessions………………………………………………248
Figure 44: Fullan and Langworthy’s (2014) Continuum of New Pedagogies Effectiveness……………………………………………………………………263
Figure 45: Location of Learning Partnerships in All the Learning Tasks in the Pedagogy Component of Fullan and Langworthy’s (2014) Continuum of New Pedagogies Effectiveness………………………………………………264
Figure 46: Location of Learning Partnerships in the Programming Task in Pedagogy Component of Fullan and Langworthy’s (2014) Continuum of New Pedagogies Effectiveness………………………………………………266
Figure 47: Location of Learning Tasks in Tasks and Assessments Component of Fullan and Langworthy’s (2014) Continuum of New Pedagogies Effectiveness……………………………………………………………………280
Figure 48: Location of Teacher Use of Digital Learning Tools and Resources/Technologies in Tech Use by Teacher Component of Fullan and Langworthy’s (2014) Continuum of New Pedagogies Effectiveness………………288
Figure 49: Location of Student Use of Digital Learning Tools and Resources/Technologies in Tech Use by Student Component of Fullan and Langworthy’s (2014) Continuum of New Pedagogies Effectiveness…………..289

Figure 50: Design and implementation of learning tasks’ activities as a collaborative knowledge-building process informed by Stahl’s (2000) diagram of knowledge-building processes………………………………………………….318
Chapter 1: Introduction and Background to the Research

Educational Technology Context for Research

This research study is set in the learning environments context of the educational technology creating domain, which describes how the “meanings and methods of creating . . . learning environments and larger teaching-learning systems . . . have evolved as the spotlight has moved from one media form to another throughout the modern history of the [educational technology] field” (Molenda & Boling, 2008, p. 82). The learning environments context of the educational technology field is referred to as “physical or virtual space[s] that [have] been designed to provide optimal conditions for learning, including access to rich resources, possibly focused on a problem and possibly supporting exploratory learning” (Molenda & Boling, 2008, p. 122).

The research is suitably placed in this domain since it continues the historical trend of understanding paradigm shifts, which tend to result when new media impact learning environments. A historical review of the educational technology field reveals that “new media tend to trigger paradigm shifts” in learning environments. Within those paradigm shifts, new or modified instructional models are designed to facilitate learning and improve performance. For instance, during the 1950s and 1960s, “as the new psychological technologies confronted the Audiovisual (AV) paradigm” (Molenda & Boling, 2008, p. 82), the first great paradigm shift resulted. In this paradigm,

the focus shifted to what learners were doing, rather than what they were watching, and so the focus of design and production shifted from making AV presentations to creating learning environments in which learners had the opportunity to practice new skills under conditions of constant feedback (Molenda & Boling, 2008, p. 82).
“After the birth of microcomputers in the early 1980s, . . . the information technology movement brought a whole new set of people, with different ideas and mindsets”, into the study and practice of educational technology (Molenda & Boling, 2008, p. 83). As a result, Computer-Assisted Instruction (CAI) became a dominant paradigm. The instructional strategies featured in early CAI programs followed a drill and practice or tutorial format similar to teaching machines or programmed instruction books, which involved small units of information followed by a question and the student’s response. A correct response was confirmed while an incorrect response might branch the learner to a remedial sequence or an easier question (Molenda & Boling, 2008, pp. 83, 93).

In the 21st century, new and more sophisticated media or emerging technologies, and new types of learners—identified as the net generation and generation next (Tapscott, 2009), have impacted and are still impacting the traditional K-12 learning environment, for instance. As a result, paradigm shifts have resulted, although debatable, to include online, blended and mobile learning to complement traditional methods in an attempt to facilitate learning and improve the performance of these new types of learners. The following Figure 1 is my graphical representation of these shifts and the conceptual framework within which this research study is set:

*Figure 1. Conceptual framework for the impact of new media and new learners on K-12 learning environment*
Within these paradigm shifts, the modified or new pedagogies need to include instructional strategies that reflect and support the learning styles of the new types of learners who are constantly using new and sophisticated media or emerging technologies.

**Statement of the Problem**

Set within this context, one of the main challenges faced by K-12 educators in some Canadian schools is to find new ways or innovative pedagogies to intellectually engage their students in deep learning of curriculum content and to promote their development and use of 21st century competencies in the formal classroom context (Dunleavy & Milton, 2009; Fullan and Langworthy, 2014; Millar, 2015). As such, educators aim to use pedagogies that have the potential to challenge students in meaningful and authentic ways (Dunleavy & Milton, 2009)—approaches to learning that focus on learning as “an immersive experience design rather than learning as curriculum design” (Kebritchi & Hirumi, 2008, p. 2).

Some school communities are attempting to address this challenge by embracing a culture of inquiry in which students become more engaged in their learning to build new understandings, meanings, and sharing of knowledge using technology (Alberta Education, 2014). However, these attempts are offset by the continued underlying influence of the industrial-aged or standard model of education in some school communities (Sawyer, 2007).

The structural configuration of the standard model of education makes it very difficult for teachers to create learning environments that intellectually engage students in deep learning of curriculum content and their development and use of 21st century competencies. The standard model “revolve[s] around the teacher who delivers a one-size-fits all, one-way broadcast learning, one-way lecture . . . the student, working alone, is expected to absorb vast quantities of content delivered by the teacher” (Tapscott, 2009, p. 122). Students are expected to memorize
and master the same regimented and articulated core curriculum to enforce standardization (Sawyer, 2006). Research continues to show that most instructional time comprises seatwork and whole-class instruction led by the teacher (Jacobsen & Friesen, 2011).

For instance, in their research carried out in the high schools of 23 school jurisdictions in Alberta, Daniels, Friesen, Jacobsen and Varnhagen (2010) report that although they observed the use of some innovative and engaged teaching and learning practices, student engagement in learning and knowledge building was low. In most of the classrooms, we found little evidence of students completing authentic tasks or of rigorous and complex work being designed for and required of high school students. The predominant use of technology we saw in these classrooms was watching or listening to the teacher present material to the entire class (Technology and Student Engagement in High School section, para. 1).

According to Parsons and Taylor (2011), “expecting students to sit still and be attentive for five hours a day, listening to content they deem unimportant is a recipe for failure for most students, teachers and schools” (p. 35).

Most of these students, as described by Tapscott (2009), who categorizes them, as the Net Generation and Generation Next, are immersed in interactive digital technology over long periods of time . . . process visual information at ‘lightning speed’ . . . are natural collaborators . . . have the ability to multitask . . . love to innovate . . . are not content to sit quietly and listen to a teacher lecture . . . want [their education] to be interesting, even fun . . . are keen to try new things often at high speed (pp. 79-126).

Many of today’s students seem to prefer to learn by doing rather than being told what to do or just reading a textbook or manual. They want to be engaged and constantly connected with
first-person learning (Junco & Mastrodicasa, 2007; Oblinger & Oblinger, 2005a). They represent a new audience that is engaged in gaming, multitasking and social networking (Jenkins, Clinton, Purushotma, Weigel & Robison, 2006). These students are interested in their learning and “are willing to learn; they are highly capable of learning; and they are ready to learn (if not impatiently so). But unlike any cohort of students before them, they clearly and confidently want to learn on their own terms” (Parsons & Taylor, 2011, p. 31).

However, “the pedagogy and technologies of the past are not engaging today’s students because these students are ‘miles ahead of us’ before we even begin” (Parsons & Taylor, 2011, p. 31). Even with the adoption of new technologies in more recent classroom teaching and learning, there is still evidence that these technologies are not effectively engaging today’s students (Daniels, Jacobsen, Varnhagen & Friesen, 2013). Instead, they are mostly used to “automate conventional models of teaching, as though the goal were to continue pursuing a narrow set of learning goals related to preparation for an industrial economy” (Dede, 2014, p. 5).

According to Johnson (2015), “We have gone about as far as we can go with isolated instruction and learning” (Introduction section, para. 1). Students are “chronically bored in school—deeply, psychologically uninterested in formal education” (Millar, 2015). “Students greet teachers’ attempts to deliver content knowledge using traditional didactic approaches with scepticism. . . Once they have mastered basic skills, students know there is so much more ‘out there’ and are unimpressed by pre-packaged, depersonalised learning experiences” (Fullan & Langworthy, 2014, p. 12). Therefore, “instead of traditional, passive teacher-led lectures, today’s students need to be

[intellectually engaged] with knowledge that matters, solve real problems [that] can make a difference in the world, be respected, see how subjects are interconnected, learn from, and with each other and people in their community, connect with experts and expertise,
and have more opportunities for dialogue and conversation (Dunleavy & Milton, 2009, p. 10, emphasis added).

Their teachers need to academically and intellectually engage them in rigorous and complex work that can motivate them to explore ideas and develop explanations, solutions and experiences that can prepare them to embrace the complex social, economic, political and cultural contexts that are constantly changing (Jacobsen & Friesen, 2011). Students need experiences that connect their hearts, hands and minds for learning; that invite them into the curriculum in ways that allow them to experience it as something real, something they can “nudge about and look at from different sides, take apart, try out, become fascinated with . . . try to reinvent” (Bereiter, n.d., p. 139) and become passionate about. Engaging students in the curriculum in this way is the foundation for what Bereiter (n.d.) refers to as “intelligent action” (p. 21) and what the Canadian Education Association (CEA) has advanced as the concept of intellectual engagement (Dunleavy & Milton, 2009).

This form of engagement is also identified as a state of intrinsic motivation manifested by intense emotional and intellectual excitement or ‘flow’, defined as a state in which people are so involved in an activity that nothing else seems to matter; the experience is so enjoyable that people will continue to do it even at great cost, for the sheer sake of doing it (Cskikszentmihalyi, 1990, p. 4).

As explained in an OECD report (2007), it is during that flow state that the brain begins to make connections and see patterns in the information, which may result in a “powerful illumination which comes from understanding” (p. 72) and is described as “the most intense pleasure the brain can experience in a learning context” (p. 73). This experience fosters motivation as students experience the pleasure inherent in deep learning (Friesen, 2007).
Teaching and learning work in schools should also adequately promote students’ development of 21st century competencies. “Development of competence requires experiences that cause students to think, play, and do things with ideas, practices and tools that, in turn, give rise to deep conceptual understanding” (Dunleavy, Milton & Crawford, 2010, p. 5). According to Hilton (2015), “Because 21st century competencies support deeper learning of school subjects, their widespread acquisition could potentially reduce disparities in educational attainment, preparing a broader swath of young people for successful adult outcomes at work and in other life arenas” (Next steps section, para. 1).

A detailed description of some of the core 21st century competencies that teachers should help every child to develop is presented in Table 1 (Appendix A). These competencies can be acquired, and result from experiences that engage learners in thinking, doing and feeling as ways to promote a deeper understanding of what they are learning (Dunleavy & Milton, 2009).

The challenge of designing meaningful school learning experiences to sponsor the development of 21st century competencies, and promote deep learning and intellectual engagement, is further compounded by the challenges some teachers face in designing appropriate assessments for and as student learning as opposed to assessments of student learning, which is mainly designed for the standard model of education. In Alberta, for instance, standardized tests are used at grades 3, 6, 9 and diploma exams in grade 12, and these tests tend to “assess relatively superficial knowledge or evaluate decontextualized and compartmentalized knowledge . . . and [do not assess 21st century competencies including] the deep knowledge required by the knowledge society” (Sawyer, 2006, p. 9) or “deep learning or the acquisition of complex competencies” (Shute & Ventura, 2013, p. 11).

Armstrong (2006) also noted that standardized testing is still the norm in some public schools, encouraging teachers to focus more on preparing their students for tests, rather than
learning for its own sake. This, therefore, leads teachers to mainly teach to the test, which “narrows the curriculum and forces teachers and students to concentrate on memorizing isolated facts” (FairTest, 2004, p. 1). As a result, instead of creating learning experiences which encourage their students to explore the curriculum content and problems in creative and unpredictable ways, some teachers are forced to create learning experiences that replicate test conditions.

These teachers tend to resist innovative pedagogical methods and changes that might take time away from preparing for the tests because of the priority placed on the outcomes of standardized, provincial exams by school and jurisdiction leaders, the provincial ministry and the community. However, today’s students do need learning experiences accompanied by assessments that are “more about ‘learning for further development’ and less about ‘marking according to standard expectations’ to meet externally dictated accountability measures” (Parsons & Taylor, 2011, p. 46).

New assessment strategies [that] seek to inspire and inform students to achieve high-quality work. These assessment strategies [should be] built on ideas of descriptive feedback that show students how they can improve their own work, the availability of exemplars that enable students to see what good work looks like, and rubrics that describe standards for different levels of performance (Dunleavy, Willms, Milton & Friesen, 2012, p. 6).

These assessments need to be more authentic, capturing aspects of students’ knowledge, deep understanding, problem-solving skills, social skills and attitudes that are needed to function in the knowledge society and complex world. They also need to allow for learner-specific evaluation and self-assessment to examine their strengths and weaknesses, to set their own goals to further their learning (University of Alberta and University of Lethbridge, n.d.) as well as
measure 21st century competencies. Therefore, in an effort to address one of the main challenges faced by K-12 educators in some Canadian schools and which was contextualized in this formal statement of the problem, a design solution in the form of an intervention was proposed.

**The Intervention/Research-Informed Design Solution and Rationale**

The intervention needed to reflect and support the learning styles of the new types of learners who are constantly using new sophisticated media or emerging technologies—technologies that inherently employ relevant and well-known educational principles and support all five learning capabilities, which include motor skills, attitude, verbal information, cognitive strategy and intellectual skills or Gagne’s nine events of instructions (Gagne, Briggs & Wager, 1992). The intervention also needed to represent the type of learning environments that:

- students enjoy and are using outside the formal classroom context in “creative, entertaining and collaborative ways” (Jacobsen, 2010, A shifting Digital World, section, para. 3);

- teachers can use to create classroom-based “strong discipline-based inquiry work [that] exhibits a number of very discernible characteristics” (Jacobsen, 2010, Teaching and Learning in the Digital Age section, para. 3), such as intellectually engaging and authentic tasks that demonstrate deep understanding of specified content through active participation in knowledge construction, while being equipped with 21st century competencies;

- provide for comprehensive and continuous work with ideas and practices that disrupt the established assumptions about teaching, learning and educational outcomes (Dunleavy & Milton, 2009).
Learning sciences research demonstrates that only active participation in the construction of knowledge will encourage deeper conceptual understanding of disciplinary concepts with increased motivation to learning. When students gain a deeper conceptual understanding, they tend to learn facts and procedures in a much more useful way that transfers to real-world settings (Sawyer, 2006).

A number of studies (Jacobsen, Saar & Friesen, 2010; Pascarella & Terenzini, 2005; Willms, Friesen & Milton, 2009) have also shown connections between student engagement, the learning environment and teaching practices. These studies seem to establish clear correlations between student engagement and the types of instructional practices teachers use, the nature of the tasks students are asked to do, the types of technologies students utilize in their learning, and the amount and type of ongoing feedback students receive while they are learning (Friesen, 2007, p. 7).

Research by Newmann, Wehlage and Lamborn (1992) has also shown the connections between student engagement and the depth of student learning.

The intervention chosen as a design solution in this study needed to form part of the portfolio of teaching practices that are less and less about crafting a single message for individuals to consume, and more and more about convening groups of learners with diverse strengths, expertise and skills around shared interests, to work on common goals, to create ideas, and to build and cultivate community knowledge (Jacobsen & Friesen, 2011, Learning Environments in the 21st Century section, para. 2).

Jacobsen, Saar and Friesen (2010) claimed that this will ensure that “students can become engaged in challenging work that has value beyond the classroom—in authentic, inquiry-based tasks that captivate their hearts and minds” (Teaching and Learning in the Digital Age section,
They noted that there are “many benefits for both students and teachers when learning in such contexts, using technology in appropriate and innovative ways” (Teaching and Learning in the Digital Age section, para. 3).

The intervention needed to give students greater control of their learning allowing them to participate in learning experiences that promote increased “peer interaction and access to [other students’] ideas, experiences, and knowledge” (Jacobsen, 2010, Effective Social Learning Online section, para. 6) and offer “innumerable opportunities for students to find and join niche communities where they can benefit from the opportunities for distributed cognitive apprenticeship” (Brown & Adler, 2008, p. 28). It also needed to allow both teachers and students (at individual and community levels) to reflect on teaching practices and student learning within and beyond the formal classroom context. Jacobsen, Saar and Friesen (2010) argued that reflection on learning is important, both for students and for teachers, and this, too, can be enhanced by appropriate uses of interactive technologies. Students learn better when they express their developing knowledge—either through conversation, or by creating written assignments, media artifacts, or visual messages [individually and with their peers]—and are provided with opportunities to reflectively analyze their state of knowledge. Research has also demonstrated that the more opportunities teachers have to work collaboratively with colleagues and professional development experts, to engage in professional dialogue about teaching and learning, and to make their work public, the more engaged they become in inquiring into and strengthening their own practices (Teaching and Learning in the Digital Age section, para. 5).

Based on the foregoing, one such intervention that can meet these requirements is digital video-gaming, specifically, the design and building of digital video games, which also taps into the interest that many young people already have in video games—94% of girls and 99% of boys
Play video games (Lenhart et al., 2008). Subtly using it in the formal classroom context can be a different, authentic, “creative, entertaining, and collaborative [way]” (Jacobsen, 2010, A shifting Digital World section, para. 3) that teachers can consider as an alternative pedagogy adapted to their new audience, a pedagogy to embrace change (Thomas & Brown, 2011; Williamson, 2008) and that can possibly address one of the main challenges faced by K-12 educators, as formally stated in the purpose of the research.

**Purpose of the Research**

The purpose of this research study is to carry out an intervention, the design and building of digital video games to explore its potential and effectiveness as a new way or innovative pedagogy that can possibly address one of the main challenges faced by K-12 educators in some Canadian schools—finding new ways or innovative pedagogies to intellectually engage their students in deep learning of curriculum content and promote the development and use of 21st century competencies. The implementation of the intervention takes place in one macro-cycle of the design-based research process, and is explored in the prototyping phase of that process in three learning tasks—game concept development, storyboarding and programming, the stages in which the actual design and building of the video games take place.

The exploration of this intervention draws upon situated learning theory, more specifically, Herrington and Oliver’s (2000) nine characteristics of the evolving theory of situated learning environments as its theoretical framework and is informed by a framework for its design and implementation. It is also at this stage of the process that data is collected and analyzed to inform any iterations to the learning tasks for their effective implementation in the educational context and to address the questions that guide the research and by extension, the problem that initiated this study.
Research Questions

1. In what ways do teachers’ design of instruction and learning tasks need to shift when designing and building digital video games to intellectually engage students in deep learning of curriculum content and to develop and use 21st century competencies, in school?

2. In what ways does the design and building of digital video games in school impact students’ intellectual engagement, deep learning of curriculum content and the development and use of 21st century competencies?

Significance of the Research

In design-based research, the consequentiality of the research is an essential criterion for determining the significance of the study. Therefore, as a consequence of the research, the findings of this study are significant on several levels. On one level, the findings of this research study have had local impact and have informed the participating teachers and their students. Beyond the local context, the findings of this study have significance for other K-12 educators (administrators, teachers) and their students, parents, design-based researchers, school jurisdictions, Alberta Education and other stakeholders as to the potential and effectiveness of the design and building of digital video games as an innovative pedagogy that can be adopted and implemented in the K-12 learning environment to intellectually engage students in deep learning of curriculum content, while also equipping them with 21st century competencies.

On another level, the findings will inform the research base in game-based learning on how the design and building of digital video games, as implemented in this present research study, may have possibly addressed some of the concerns/unplanned effects and gaps identified in past related research studies, in and beyond the school context.
On yet another level, these findings provide some practical implications for K-12 educators and Alberta Education in the adoption and implementation of the design and building of digital video games as an innovative pedagogical framework/model that can transform the present K-12 learning environment into a more participatory and technology-enabled one to address the challenges faced by educators as new and emerging technologies continue to impact learners and the learning environment. For instance, in Chapter 7, I have included implications for:

- effective teaching and learning practice that has the potential to make a positive difference;
- the type of theoretical support that may be needed for the design and building of digital video games as a pedagogical design;
- the design of pedagogical frameworks/models that can promote deep learning, intellectual engagement and development of 21st century competencies;
- the design and implementation of learning tasks’ activities in the video game design and building context as a collaborative knowledge-building model;
- the design and implementation of learning tasks’ activities in the video game design and building context as a participatory learning environment;
- emerging design principles for learning tasks’ activities as a responsive pedagogy;
- curriculum re-design;
- implementation of technologies into formal classroom teaching and learning;
- significant contribution to the knowledge and research base of game design-based learning, and by extension, game-based learning, in school;
- the use of design-based research as an effective research approach to study game design-based learning, in school;
policy for the implementation of game design-based learning, and by extension, game-based learning, in school.

The findings also make a significant contribution to the knowledge and research base of game design-based learning, and by extension, game-based learning in school, the learning sciences and the systematic change needed in the education system to make teaching and learning more visible, relevant, interesting, engaging and authentic for a more connected and complex world.

**Definition of Terms**

In order to make the intent and purpose of the research evident, some researchers (e.g., Moustakas, 1994; Patton, 2003) suggest that the keywords of the research question(s) and one’s terms, when carrying out research, be defined and clarified. Therefore, the keywords of the questions that guided this research as well as other significant terms used to identify the primary focus of this study are defined as follows:

**Deep learning**—introduced in a study by Marton and Säljö (1976), deep learning is defined as learning that is focused on creating and using new knowledge in the world that goes beyond the mastery of existing content knowledge assisted by technologies (Fullan & Langworthy, 2014, p. 7); the analysis and synthesis of facts to create conceptual models and frameworks; the integration of prior learning and cross-referencing to other themes and subjects; learning that is active and based in relationships; emphasis on depth; assessment that is formative and negotiated; content that is remembered and codified (West-Burnham & Coates, 2005, p. 35).
**Intellectual engagement**—is defined as “a serious emotional and cognitive investment in learning, using higher order thinking skills (such as analysis and evaluation), to increase understanding, solve complex problems, or construct new knowledge” (Willms, Friesen & Milton, 2009, p. 7) and “maintained over a sustained period of time” (Jacobsen, Lock & Friesen, 2013). Dunleavy, Milton and Willms (2012) further explain when students are intellectually engaged, they are so absorbed in their work that they often lose track of time. They are interested, curious, personally invested in the quality of their work and connected with others in setting and achieving learning goals—and they carry the ideas they are learning about into their lives outside of school (p. 2).

**Twenty-first century competencies**—is adapted from Binkley, et al.’s (2010) Draft White Paper 1: Defining 21st century skills and include creativity and innovation, critical thinking, problem solving and decision-making, communication, collaboration and teamwork, information literacy, living in the world- life and career and living in the world- citizenship – local and global.

**Digital video games**—is defined and will include the following features: a game format, educational objectives, multimodal representations, feedback mechanisms, information provided to users, tools to track users’ knowledge and proficiency and adaptive pedagogical mechanisms (Felicia, 2011). Although video games have been categorized to include genres such as action, fighting, driving or flying, sports, 3D shooter, card or board, strategy, fantasy role playing, adventure, multiplayer, and massively multiplayer online role-playing games (MMORPG) (Prensky, 2001; Quinn, 2005), in this research study, they were also categorized to include:

- the type of interaction the games required of the player (Apperley, 2006);
- the learning approach they utilized—“practice and feedback, learning by doing, learning from mistakes, goal-oriented learning, discovery learning and guided
discovery, . . . constructivist learning, accelerated (multi-sense) learning intelligent tutoring” (Prensky, 2001, p. 157), constructionist learning and situated learning;

- their suggested noted learning outcomes—the development of specific skills: attention, problem-solving, decision-making, collaborative work, creativity, and ICT skills (Aguilera & Mendiz, 2003) and other competencies identified by Binkley et al. (2010);

- deductive reasoning and hypothesis testing (Aguilera & Mendiz, 2003; Gee, 2003; Lunce, 2006; Prensky, 2006);

- mastery of abstract and conceptual knowledge (Aguilera & Mendiz, 2003; Gee, 2003; Lunce, 2006; Prensky, 2006);

- the learning goals and objectives they support.

**Design-based research (DBR) approach**—The design-based research approach, as defined by Wang and Hannafin (2005) is a systematic but flexible methodology aimed to improve educational practices through iterative analysis, design, development, and implementation, based on collaboration among researchers and practitioners in real-world settings, and leading to contextually sensitive design principles and theories (p. 6).

**Macro-cycle**—constitutes a regulative cycle of the entire design-based research process comprising its three core phases—the preliminary research or analysis and exploration phase, prototyping or design and construction phase and assessment or evaluation and reflection phase (McKenney & Reeves, 2012). This cycle reveals the complexity of the intervention, its implementation and theoretical foundation (Shah, Ensminger & Their, 2015). Each of these core phases of the DBR process involves at least one micro-cycle or “cycle of action with its own logical chain of reasoning” (McKenney & Reeves, 2012, p. 77) concerned with generating local
and practical knowledge regarding the use and implementation of the intervention (Shah, et al., 2015).

Within a macro-cycle of the entire design-based research process, if at least, two micro-cycles of action are undertaken in a core phase of the DBR process to generate local and practical knowledge regarding the use and implementation of the intervention, meso-cycles result (McKenney & Reeves, 2012; Shah, et al., 2015). For instance, in this research study, meso-cycles were undertaken in each learning task in the prototyping phase as tasks’ activities were explored (one micro-cycle), formatively evaluated and then re-defined (one micro-cycle) until successive approximations of the desired tasks’ activities were achieved to meet the learning and intervention goals (McKenney & Reeves, 2012).

**Structural Layout of the Research**

This design-based research study is organized into seven chapters. Chapter one has provided an overview of the background to the research that included its educational technology context, a formal statement of the problem, the identification of the design solution or intervention with a discussion of the rationale for choosing this intervention, a statement of the purpose of the research and the research questions, a discussion of the significance of the research, definition of the terms reflected in the research questions, as well as other significant terms used to identify the primary focus of this research, and finally, the structural organization of the research study.

Chapter Two provides a review of the literature that includes an overview of the game design-based learning context, some of the learning theories supporting game design-based learning, a theoretical framework to guide the design, implementation and exploration of the intervention in the prototyping phase of the DBR process and a review of some of the major
documented studies in which the design and building of digital video games was explored within and beyond the school context.

Chapter Three describes the methodological approach of this research, which comprises a discussion of the research design utilized, the instruments and procedures used to collect the data, the procedures used to analyze the collected data, a discussion of the ethical considerations for the research and the limitations encountered in carrying out the research.

Chapter Four presents a detailed description of the implementation and exploration of the intervention during the prototyping phase of the design-based research process, and the findings, based on the analysis of the data collected during this implementation and exploration are presented in Chapter Five. These findings are supported by direct quotes from the interviews with respondents (teacher and student participants), transcribed audio-taped discussions/conversations during the game design and building sessions, excerpts from teachers’ blog, Kidblogs, teachers’ documents (game design unit plan, assessment rubrics, feedback), teaching moments, formative assessments, students’ Google documents, students’ self and peer assessments, video-taped group activities and student game artifacts, which include game concepts, storyboards and game prototypes.

Chapter Six focuses on a discussion of the findings in an effort to assess/evaluate and reflect on the potential and effectiveness of the design and building of digital video games as an innovative pedagogy and in addressing some of the concerns/unplanned effects and gaps identified in past related research studies. Chapter Seven concludes the research and discusses some of the practical implications of this research for K-12 educators (teachers and administrators), school jurisdictions and Alberta Education. Recommendations for K-12 educators (teachers and administrators), school jurisdictions and for further research based on the findings and implications of this research are also suggested.
Chapter 2: A Review of the literature

Introduction

In this research study, the design and building of digital video games was implemented and explored as a design solution or an innovative way or pedagogy to address one of the main challenges faced by K-12 educators—finding new ways or innovative pedagogies to intellectually engage their students in deep learning of curriculum content, and to promote the development and use of 21st century competencies. A rationale for using it as a design solution or intervention has been discussed in the background to the research, in this study.

However, to further support this rationale and to ground the research in the literature and in theory, it is necessary to carry out a review of the game-based learning literature. This review examines (i) the game design-based learning context, within which the design and building of digital video games is located; (ii) the learning theories that support this context; (iii) a theoretical framework, informed by these theories, to guide the design and building of the students’/groups’ digital video games, in this study; (iv) some of the major documented studies that have explored the design and building of digital video games, within and beyond the school context; and (v) the implications of the findings of these related studies for the goals of this current study. This review is, therefore, guided by the following questions:

1. What does the game-based learning literature reveal about the game design-based learning context?
2. What are some of the learning theories that support game design-based learning?
3. How do these theories inform a theoretical framework to guide the design and building of the students’/groups’ digital video games in this current study and to address the questions that guide this research?
4. What other studies have been carried out using the design and building of digital video games as an intervention, within and beyond the school context?

5. How do the findings of these studies inform this current research?

As such, this review is presented in four sections. Section one provides an overview of the game design-based learning context. Section two examines the learning theories supporting game design-based learning. Section three presents a theoretical framework, informed by these learning theories, to support and guide the design and building of the students’/groups’ digital video games during the implementation of the learning tasks in this current study. Section four examines some of the major documented studies that explored the design and building of digital video games, within and beyond the school context, by analyzing and synthesizing their empirical findings and identifies how these studies inform the current one.

**Game Design-Based Learning Context**

**Overview**

The research intervention, the design and building of digital video games, falls neatly into the game design-based learning (GDBL) context, a subset of the game-based learning context. Game design-based learning, also referred to as game development-based learning (Wu & Wang, 2012) or variants such as, game design (GD) and game making (GM) (Kamenetz, 2013; Robertson, 2012), is not new, but has been used as a less familiar approach compared to game play-based learning (GPBL) in the game-based learning context. Salen (2007) defined game design as a complex, multi-layered design activity, whereby systems of meaning (games) are created through the design of rule sets resulting in play . . . and involves a rich array of knowledge and skills—knowledge of how to put together a successful game, which
involves system-based thinking, iterative critical problem solving, art and aesthetics, writing and storytelling, interactive design, game logic and rules, and programming skills (pp. 305, 315).

She further explained that learners as game designers must be socio-technical engineers, thinking about how people will interact with the game and how the game will shape both competitive and collaborative social interaction. They must explicate and defend their design ideas, describe design issues and player interactions at a meta-level, create and test hypotheses, and reflect on the impact of their games as a distinctive form of media in relation to other media. Each of these involves a melding of technological, social, communicational, and artistic concerns, in the framework of a form of scientific thinking in the broad sense of the term, for example, hypothesis and theory testing, reflection and revision based on evidence (p. 305).

Kafai (1995) has noted that design also “involves the building of artifacts or objects” (p. 11). She explained that the “design of a . . . game can turn into an object-to-think-with that engages students’ thinking, feeling and learning [and] learning through design emphasizes that learning is most effective, when children build personal, meaningful objects” (p. 11).

Researchers, for instance, Tzuo, Isabelle, Ling, Yang and Chen (2012), claimed that GD could be “adopted in school purposefully for integrated learning” as it “requires the application of knowledge by interpretation and creation” (p. 422). They also stated that such “learning is dialectical and recursive, revolving around multimodal thinking and producing” (p. 422). Years earlier, researchers in GD, such as Kafai (1995), reported similar findings on how GD promoted the application of students’ knowledge through the integration of activities involving inquiry, illustration and instruction as they embraced multiple roles as experts, teachers, learners,
designers and players. Scaife and Rogers (1998) who worked with game-design projects that involved teens, also emphasized how game design-based learning required students to interpret phenomena or apply knowledge from multiple perspectives.

Tzuo et al. (2012) have also claimed that in GD, “learning is signified at the macro level through reinterpreting and creating, which in turn, leads to societal re-conceptualization by the reconstruction of values, knowledge and meanings” (p. 423). They also explained that during the game design process, “identity is reformed along with learning and knowing . . . through triangulating the perspectives of designers and players when creating the story line and designing the task” (p. 423).

Research has also indicated that game design-based learning enhances areas of subject learning and development of critical thinking skills. For instance, Mathews (2010) claimed that in critical socio-cultural studies, it helps to promote the learner’s ability to analyze and interpret present or past events by using a holistic view that takes background and context into account. Myers (2008) reported that in language arts, it has been used to enhance 21st century literacy skills in terms of meaning production, interpretation and practices when reading and writing. Sanford and Madill (2007) have also reported that as students designed their games, “critical thinking emerge[d] naturally during the process of producing the game narratives” (p. 451).

**Game-Design Principles for Educational Contexts**

When designing and building their digital video games in educational contexts, there are game design principles that students, as game designers, need to take into consideration. These design principles are categorized as embedded educational characteristics of gaming, learning and technical aspects (adapted from Mellini, Talamo & Giorgi’s, 2010) as seen in Table 2. Specific details of the embedded educational characteristics of the gaming, learning and technical aspects are presented in Table 3 (Appendix B).
In this research study, explicit links were made between these game design principles and the learning tasks’ activities in the design and building of the video games by teachers and students/groups, in terms of developing stories or game concepts, storyboarding these game concepts and programming game prototypes in Scratch, the chosen game building software for the intervention. For instance, the educational characteristics of the gaming and technical aspects particularly informed the storyboarding and programming of the game concepts, while the educational characteristics of the learning aspects informed all three—the development of the game concepts and the storyboarding and programming of these game concepts.

**Learning Theories Supporting Game Design-Based Learning**

Based on a review of the literature, researchers have identified and discussed some of the learning theories that tend to support game design-based learning. Situated learning (Collins, Brown, & Newman, 1989; Gibson, Aldrich & Prensky, 2007; Zibit & Gibson, 2005), constructivism (Dede, Nelson, Ketelhut, Clarke & Bowman, 2004; Dickey, 2005, 2006; Gee,
2003; Schrier, 2006) and constructionism (Robertson et al., 2004; Robertson & Good, 2005) were three of the main theories identified and discussed.

**Situated Learning Theory**

Situated learning theory (Lave, 1991) also referred to as situated cognition theory (Brown, Collins, & Duguid, 1989) relies on the belief that knowledge is “contextually situated and is fundamentally influenced by the activity, context and culture in which it is used” (McLellan, 1985, p. 6). From a situated learning perspective, the environment represents an interconnected system of relationships and is not distinct from the learner (Barab & Roth, 2006). Within that environment, individuals observe and act based on the affordances and constraints of the environment and the situations that may arise within it (Greeno, 1994).

In situated learning, the gap between school-based and real-world learning tends to be eliminated and because it can take place in culturally and socially diverse settings, the learning environment can be dynamic (Duffy & Cunningham, 1996; Henning, 1998). In such an environment, students tend to learn content through activities, amidst the noise, confusion, and group interactions, rather than from instructor-created learning packages (Lankard, 1995). As students engage in situated learning activities, they also tend to exhibit emergent meta-cognitive behaviors (Land & Hannafin, 2000).

Situated learning places the student in the center of the teaching and learning process integrating content—the facts and processes of the task; context—the situations, beliefs, values, and environmental cues through which the learner gains and masters content; community—the group with which the learner will create and discuss meanings of the situation; and participation—the process by which learners work with each other and with experts in a social organization to solve problems related to everyday life situations (Brown, Collins & Duguid, 1989; Lave, 1988).
Situated learning theory has been further developed to emphasize the idea of “cognitive apprenticeship” (Collins, Brown & Newman, 1987, p. 5; Serrano & Tormey, 2010). Expanding on this idea, Brown, Collins and Duguid (1989) argued that since meaningful learning will only take place if it is embedded in the social and physical contexts within which it will be used, one way to achieve authenticity was through cognitive apprenticeship, a method designed to “enculturate students into authentic practices through authentic activity and social interaction in a way similar to that which is evident--and evidently successful--in craft apprenticeship” (p. 10). They noted that in cognitive apprenticeship, teachers promote the learning of a task by first modeling their strategies for students, then supporting the students’ attempts at doing the task and finally empowering the students to continue independent of them. Collins, Brown and Holum (1991) also noted that in cognitive apprenticeship, “the challenge is to situate the abstract tasks of the school curriculum in contexts that make sense to students” (p. 3). Teachers, therefore, need to situate these abstract tasks in authentic contexts and diverse situations so that the students can understand the relevance of the work and be able to transfer what they learn.

One of the critical aspects of situated learning is its notion of the participant as an observer in the community of practice. Lave and Wenger (1991) proposed that participation in a culture of practice can, in the first instance, be observation from the “boundary or ‘legitimate peripheral participation’” (p. 110). They explained that as learning and involvement in the culture increase, the participant moves from observer to a fully functioning member—legitimate peripheral participation enables the learner to progressively learn and understand the culture of the group and what it means to be a member. “To be able to participate in a legitimately peripheral way entails that newcomers have broad access to arenas of mature practice” (p. 110).
**Situated Learning as a Model of Instruction**

In the literature, some researchers (Bransford, Sherwood, Hasselbring, Kinzer & Williams, 1990; Griffin, 1995; Young, 1993) supported the claim that the situated learning approach can be used successfully as a model of instruction. Although the publication of situated learning as a model of instruction has met with much interest, it is widely debated and criticized (Herrington & Oliver, 1995). Some critics have argued that if this model is to succeed in the classroom, teachers need to be teachers or ‘masters’ in their practice or expose students to ‘masters’ or experts in the field of study (Tripp, 1993). Criticisms have also been levelled at claims that computer-based materials have used situated learning as a framework in their design (Herrington & Oliver, 1995).

Despite these criticisms, there seems to be increasing agreement that computer-based representations and ‘microworlds’ or virtual environments, for instance, do provide a powerful and acceptable medium for the critical characteristics of situated learning to be located in the formal classroom environment (Herrington & Oliver, 2000). For instance, Harley (1993) supported the potential of computer-simulated environments to situate student learning within the classroom by offering their “own genre of interactive, authentic instructional experiences particularly when considered in terms of the potential for rich Hypermedia and Virtual Reality microworlds” (p. 120). Collins (1988) also noted that “computers give us enormous power to create situated learning environments where students are learning about reading, writing, math, science and social studies in ways that reflect the kinds of activities they will need these for” (p. 3).

Many of the researchers and teachers exploring the model of situated learning have accepted that the “computer can provide an alternative to the real-life setting, and that such technology can be used without sacrificing the authentic context which is such a critical element
of the model” (Herrington & Oliver, 2000, p. 2). In agreement, McLellan (1994) pointed out that while the situated learning model dictates that knowledge must be learned in context, that context can be “the actual work setting, a highly realistic or ‘virtual’ surrogate of the actual work environment or an anchoring context such as a video or multimedia program” (p. 8).

In terms of situated learning as a model of instruction, a challenge has been put to researchers to identify the critical aspects of situated learning that can enable it to translate into teaching methods that could be applied in the classroom (Herrington & Oliver, 2000). Although McLellan (1994) identifies the key components of the situated learning model as “stories, reflection, cognitive apprenticeship, collaboration, coaching, multiple practice, articulation of learning skills, and technology” (p. 7), the contributions of various theorists and researchers, as well as the original authors of the model, have expanded and refined the notion to a much more comprehensive and far-reaching framework for the design of learning environments (Herrington & Oliver, 2000).

One such framework has been proposed and adapted by Herrington and Oliver (2000, pp. 4-7). Their framework reveals the following nine characteristics of the evolving theory of situated learning environments in which knowledge would be best constructed:

1. Authentic context that reflects the way the knowledge will be used in real-life—a situated learning environment provides an authentic context that reflects the way the knowledge will be used in real-life settings, that preserves the full context of the situation without fragmentation and decomposition, that invites exploration and allows for the natural complexity of the real world (Brown, Collins & Duguid, 1989; Brown & Duguid, 1993; Collins, Brown & Newman, 1989; CTGV, 1990, 1993a, 1993c).

2. Authentic activities—a situated learning environment also provides authentic activities which are ill-defined—students find as well as solve the problems. It is an environment
where tasks can be integrated across subject areas, and it provides the opportunity to detect relevant and irrelevant material (Brown, et al., 1989; CTGV, 1990, 1993c; Collins, et al., 1989; Young, 1993).

3. Access to expert performances and the modeling of processes—situated learning environments provide access to expert performances and the modeling of processes, allowing students to observe the task before it is attempted. Such access enables narratives and stories to be accumulated, and invites the learner to absorb strategies which employ the social periphery (legitimate peripheral participation) (Lave & Wenger, 1991; Brown, et al., 1989; Brown & Duguid, 1993).


5. Collaborative construction of knowledge—a situated learning environment supports the collaborative construction of knowledge (Brown, et al., 1989; Young, 1993).

6. Coaching and scaffolding—a situated learning environment provides for coaching at critical times and scaffolding of support, where the teacher provides the skills, strategies and links that the students are unable to provide to complete the task. Gradually, the support or scaffolding is removed until the student is able to stand alone or achieve learner autonomy (Collins, et al., 1989; Griffin, 1995; Harley, 1993; Collins, 1988; Young, 1993).

8. Articulation—a situated learning environment promotes articulation to enable tacit knowledge to be made explicit (Bransford, et al., 1990; Collins, 1988; Collins, et al., 1989).


**Constructivism**

Constructivism is a “philosophical view on how we come to understand or know” (Savery & Duffy, 2001, p. 1). Its fundamental principle is that knowledge is actively constructed by the learner (Siemens, 2004) and learning of knowledge could only be achieved through meaningful activity, and is a continuous, life-long process that results from acting in situations (Brown, et al., 1989). It also proposes that learning takes place in context (Duffy & Jonassen, 1991) and what is understood is a function of the content, context, activity of the learner and, perhaps most importantly, the goals of the learner, [meaning that], cognition is not just within the individual but rather it is a part of the entire context, that is, cognition is distributed (Savery & Duffy, 2001, p. 1).

In a constructivist environment, collaboration is an important notion. Through joint effort, it enables learners to develop their own understanding and also provides opportunities for them to collaboratively develop new understanding through argument and discussion (Vygotsky, 1978; Watson, Solomon, Dasho, Shwartz & Kendzior, 1994). It allows for a synergistic relationship between insights and solutions (Brown, et al., 1989) and also provides the means for learners to understand and learn varying points of view other than their own (Can, 2009).

Diversity is another important notion reflected in a constructivist learning environment (Can, 2009). Because individuals differ in their social backgrounds, they may have multiple
perceptions about the experiences they encounter. Multiple perspectives are widely accepted among constructivists (Duffy & Cunningham, 1996; Honebein, 1996). Learner negotiation represents the diversity of perspectives and opinions about issues (Can, 2009). Learning the same content from various conceptual perspectives, in modified contexts, at various times and for different purposes is a requirement for achieving the goals of advanced knowledge acquisition (Spiro, Feltovich, Jacobson & Coulson, 1991).

The necessary constructivist conditions for learning are summarized by Driscoll (2000):

2. Social negotiation is an integral part of learning (Piaget, 1973; Vygotsky, 1978)
3. Multiple perspectives are supported and multiple modes of representation are used (Honebein, 1996).
4. Ownership in learning is encouraged (Duffy & Cunningham, 1996).
5. Adequate time for learners’ investigation and in-depth engagement is provided (De Vries, 2002).
6. Self awareness of the knowledge construction process is nurtured (Jonassen, 2003).

Teacher participants informed their design of the learning tasks in the design and building of digital video games with these conditions, which posed as design principles that guided the design of the learning tasks’ activities (see Table 12). As they used these conditions, learning was embedded in the complex, realistic, and relevant game environment, ownership of the learning was encouraged, and self-awareness of the knowledge construction process was nurtured as learners created new knowledge through their experiences and interaction with their teachers, peers and the context (Gee, 2003; Schrier, 2006).
Constructionism

Papert (1991) extends on the theory of constructivism to incorporate a more practical notion of constructionism, which goes beyond Piaget’s (1967) constructivism in its emphasis on artifacts asserting that “meaning-construction happens particularly well when learners are engaged in building external and shareable artifacts” (Kafai & Resnick, 1996, p. 1). It also suggests that “learners are particularly likely to make new ideas when they are actively engaged in making some type of external artifact which they can reflect upon and share with others” (Kafai & Resnick, 1996, p. 1). Kafai and Resnick (1996) continue that one of the main tenets of constructionism is that learners actively construct and reconstruct knowledge out of their experiences in the world . . . [Constructionists argue] that learners are most likely to become intellectually engaged when they are working on personally meaningful activities and projects. In constructionist learning, forming new relationships with knowledge is as important as forming new representations of knowledge (p. 2).

Constructionists’ approach to the creation of knowledge emphasizes the physical interactions with objects rather than abstract formalizations. They believe that working on context-specific projects that are personally meaningful require the manipulation of virtual or concrete objects that will assist students in the learning process (Carbonaro, 1997). Penner (2001) also suggested that “there is a continuous interaction between thought and action. From this perspective, the starting point of all learning resides in the premise that the mind and body are extended and transformed by artifacts situated in activities” (p. 8).

“Constructionism has a long history of incorporating aspects of video games to achieve desired learning goals” (Weintrop, Holbert, Wilensky & Horn, 2012, p. 645). For instance, Papert and Harel (1991) noted how early LOGO projects utilized game design as a catalyst for
construction, while other researchers (e.g., Goldstein, Kalas, Noss & Pratt, 2001) noted how the design of the tools learners used when engaging in constructionist activities were informed by video games. Caperton (2010) has also claimed that some recent constructionist programs have utilized the building of video games as central to constructionist learning, with the increasing popularity of video games in youth culture.

**Informed Theoretical Framework for Proposed Intervention**

Constructivist and constructionist approaches to learning share similar conditions for learning with situated learning theory, that is, they mutually support or are subsets of situated learning. Therefore, the theoretical framework to guide the design, implementation and exploration of the intervention in the prototyping phase of the DBR process, in this research study, drew mainly from situated learning theory, more specifically, Herrington and Oliver’s (2000) nine-element framework. A discussion on how it informed the designed framework/model for its design implementation and exploration follows:

**Authentic Context**

The formal classroom context at a charter school in Calgary represented the game design learning environment as an authentic context that reflected the way knowledge will be used. As such, this learning environment was all-embracing, reflecting the ways that the knowledge constructed could be used in real-life and not separated from the noise, confusion, and group interactions prevalent in real work environments. It was an environment that invited a great deal of collaborative exploration, allowing for the natural complexity of the real world, while enabling sustained examination from different perspectives (Brown et al., 1989; Reeves & Reeves, 1997).
**Authentic Activities**

The learning tasks’ activities to promote the design and building of students’/groups’ video games represented authentic and ill-defined game design and building activities (game concept development, storyboarding and programming) with real-world relevance (historical and modern day governments). These activities were also implemented as complex learning tasks to be completed over a sustained period of time (Brown et al., 1989; Reeves & Reeves, 1997). The emphasis, here, was “on meta-cognitive processes and on a holistic view of the task(s)” (Honebein, Duffy & Fishman, 1993, p. 90).

**Access to Expert Performances and the Modeling of Processes**

In this video game design and building environment, student participants continuously accessed and interacted with their teachers, who functioned as the curriculum content experts and designers of the student learning process. The student participants also interacted with their peers, many of whom were expert video game players and with some experience in building video games. Through this interaction with their peers, within and across groups, student participants were allowed to play various types of video games including those built in Scratch. Playing the Scratch games also allowed students to ‘see inside’ the games as they accessed the scripts, costumes and sounds to become familiar with how other video game designers coded/programmed their video games.

**Multiple Roles and Perspectives**

As teacher participants designed their instruction and the learning tasks’ activities, they assumed multiple roles to allow them to design and implement their instruction from various perspectives. In addition to their roles as curriculum content experts and designers of the student learning process, they also functioned as facilitators, instructors, assessors, activators of student learning, collaborators, learning coaches, reviewers and models. To participate in the learning
tasks, student participants were assigned specific roles (leaders, story writers, artists, musicians or sound engineers and programmers) which allowed them to explore and contribute their different perspectives to the design and building of their video games in an effort to communicate their understanding of how the citizens in their various models participated in the government decision-making process.

**Collaborative Construction of Knowledge**

Research studies, for example, Del Marie Rysavy and Sales (1991) have shown that there are clear educational advantages when students collaborate to predict, hypothesize and find solutions to various problems. The opportunity for the teacher and student participants to collaborate, was therefore, an important design element in the design and building of digital video games. As teachers implemented the learning tasks, they became very involved in shaping and co-constructing ideas with the students/groups and each other in their effort to mainly promote a deep learning of how the citizens in students’/groups’ various models participated in the government decision-making process. As students participated and were actively engaged in all the learning tasks, through student-student, student-group and group-group learning partnerships in their assigned roles, they also collaboratively created or developed new ideas or knowledge (game concepts, storyboards and game prototypes) in an effort to communicate their deep understanding on how the citizens in their various models participated in the government decision-making process.

**Coaching and Scaffolding**

Collins, Brown and Newman (1989) pointed out that coaching is situation-specific and is related to problems that arise as students attempt to integrate their skills and knowledge. During the learning tasks’ activities, particularly in the game concept development and storyboarding tasks, teacher participants provided an extensive amount of coaching and scaffolding, through
continuous formative assessments including discussions, “instructional conversations” (Tharp, Estrada, Dalton & Yamauchi, 2000, p. 33) and Socratic dialogues/questioning, to students/groups in order to address any misconceptions they still had about the curriculum content, the solution of the given problem and the tasks’ activities, and to offer suggestions for improvement. These suggestions were provided in the form of hints, reminders, feedback, modeling, scaffolding and fading.

Reflection

Jacobsen, Saar and Friesen (2010) noted that reflection on learning is important for students and “students learn better when they express their developing knowledge—either through conversation, or by media artifacts, or visual messages and are provided with opportunities to reflectively analyze their state of knowledge” (Teaching and Learning in the Digital Age section, para. 5). During their participation in the learning tasks’ activities, students were given opportunities to reflect on their learning and knowledge-building experiences during the formative assessments with their teachers, peer assessments, within and across groups, in their kidblogs and in the interviews with the researcher. Through these reflections, the cognitive activities of abstracting, summarizing (Jonassen, Hartley & Trueman, 1986; Rinehart, Stahl & Erickson, 1986), and organizing knowledge (Kail, 1990) tended to promote their conceptual integration and retention of the government decision-making process in their various chosen models (Ancient Athens, Iroquois Confederacy, Municipal and Provincial [current era or modern day]).

Jacobsen, Saar and Friesen (2010) also noted that reflection on learning is important for teachers as well, and that research has . . . demonstrated that the more opportunities teachers have to work collaboratively with colleagues and professional development experts, to engage in
professional dialogue about teaching and learning, . . . the more engaged they become in inquiring into and strengthening their own practices (Teaching and Learning in the Digital Age section, para. 5).

During their implementation of the learning tasks, the two teacher participants collaboratively reflected on the design of their instruction and learning tasks’ activities, their contribution to student learning and their professional learning in challenging their methods of assessment, in particular. In some instances, the teachers also collaboratively reflected on student performance and their implementation of some tasks’ activities with the professional development leader.

**Articulation**

Student participants, in collaboration with their teachers and peers, articulated, negotiated, discussed and defended their game concept and storyboarded ideas and game prototypes in an effort to communicate their deep understanding of how the citizens in their various models participated in the government decision-making process.

**Integrated Authentic Assessment**

Throughout their implementation of the learning tasks, particularly, the game concept development and storyboarding tasks, the teacher participants deliberately developed and integrated various assessment practices and approaches that reflected the context and the nature of their students and ensured that the students were a part of these assessments. These included: (i) assessments *for* their learning (formative assessments—weekly assignments, instructional conversations, discussions, Socratic dialogues/questioning, which also involved a great amount of coaching and scaffolding, with feedback loops involving large amounts of descriptive feedback) to assess their progress and to inform the modifications or refinement to their work; (ii) assessments *as* their learning (self and peer assessments—*Let’s Reflect* rubric, students/groups’ reflections in their Kidblogs, elevator pitches and group-share reflections with feedback for
improvement); and (iii) assessments of their learning (summative assessment of students’ achievement of the learning goals at the end of the process).

**Related Studies on the Design and Building of Digital Video Games**

**in and Beyond the K-12 Classroom**

In this section, I examine some of the major documented research studies in which the design and building of digital video games was explored, within and beyond the school context, by analyzing and synthesizing their empirical findings and identifying how these findings can inform the goals of this current study. To identify the documented research, a search strategy was undertaken using mostly search engines (Google Canada and Google Scholar) and online bibliographic databases (e.g., IEEE Xplore, Springer, Science direct). Searches, informed by keywords or strings (e.g., game-based learning, game design-based learning, game development-based learning, game design, game making, building or making video games in school) were limited to titles of articles published in journals, conference proceedings and books.

Research on game design or game design-based learning with specific reference to digital video games, from the 1990s to the present informed the present review of related studies because until the 1990s, documented research in this area was very scarce. It is noted, however, that after 2006, there seemed to be a rapid increase in the number of game design-based learning articles published (Wu & Wang, 2012). Reviewing related studies from the 1990s to the present will help to reveal the similarities and differences of their findings, with time, the ongoing trend of these findings and how they inform the goals of this current study.

In a study to discover how the building of digital video games could be used as a context for learning, Kafai (1995) challenged sixteen fourth-grade students to use the programming language, Logo, in order to build or create their own video games in an effort to learn and teach
fractions to third graders. Findings revealed that in designing their games, the students “engage[d] their fantasies and built relationships with other pockets of reality that went beyond traditional school approaches” (Kafai, 1995, p. 286). It also helped to promote learner autonomy by allowing the students to control their own learning and thinking, and challenging them to plan and manage the creation of their own games.

Commenting on the results of this study, Kafai et al. (1998), indicated that “a core assumption in educational game making was that students would construct their own fraction representations and in this process establish better connections between different fraction representations (such as written, symbolic, graphic) and connections to everyday objects” (p. 5). However, she discovered that “while students significantly increased their understanding of fractions, one of the problematic aspects in [the] study was the integration of fraction content and game ideas” (p. 5). She further explained that

with the exception of one game designer, all [the] students developed games with extrinsic fraction integration—a context in which [the] game idea and fraction content are unrelated. Intrinsic integration—a context in which game ideas and fraction content are related would have been a more favorable outcome. This distinction begins to sketch out a taxonomy of learning affordances, or the problematizing potential, of particular tasks: when designing an extrinsically integrated game, there are few incentives for the designers (and also for the learner) to think about the content matter (p. 5).

By 2006, after carrying out a series of studies in which 10-year-old children constructed their own educational video games, Kafai (2006) concluded that when building educational video games,

the learner is involved in all the design decisions and begins to develop technological fluency. Just as fluency in language means much more than knowing facts about the
language, technological fluency involves not only knowing how to use new technological tools but also knowing how to make things of significance with those tools and most important, develop new ways of thinking based on use of those tools (p. 4).

Her research seems to demonstrate that “designing video games makes it possible for the learner to approach a subject in an active way, thereby constructing a personal representation of knowledge by using physical artifacts” (Egenfeldt-Nielsen, 2006, p. 198). This experience portrays learning into various perspectives, while it allows for a variety of actions and a more complete understanding of the content to be learned (Mellini, Talamo & Giorgi, 2010).

In the findings of their research to investigate the educational impact of using game-making software in a classroom setting with thirty 9-10 year olds, in eight weeks, Robertson and Howells (2008) reported that the students displayed motivation and enthusiasm for learning and determination to reach a high standard of achievement as they worked on more complex aspects of their games. They further noted that the students displayed skills in independent learning, learning in groups and linking and applying learning to new situations. Based on their findings, Robertson and Howells (2008) also claimed that game authoring opportunities offer students motivating, technology-supported learning activities that promote enthusiasm and empower young learners through creative expression.

Owston, Wideman, Sinitskaya and Brown (2009), in their findings on the investigation into computer game development as a literacy activity with 3rd and 4th graders in 9 public elementary schools in Canada, noted that the teachers in the study reported that they believed there was increased content retention, higher engagement in activities related to comparing and contrasting outcomes, students’ utilization of more and different kinds of research materials, enhancement of editing skills and insight into questioning skills. In the development of digital literacy skills, teachers also reported that students shared their computer expertise and actively
helped each other resolve technical issues, increased their knowledge of the game software and used a variety of learning materials.

They also noted that some students continued to develop games on their own outside of class time, in relation to their own hobbies and interests and had to be re-directed from both these personal games and the curriculum-based games during the school day as a sign of motivation and engagement. In terms of teacher classroom practices, teachers worked together and modeled the type of higher-order thinking questions to their class and discussed them.

In exploring the experiences of 21 elementary students (ages 7–11) as they created computer games to teach others an aspect of Science, Li (2010) “focused on capturing and interpreting the students’ thinking and learning processes” (p. 2). Based on her findings, she reported that “game-building can enhance, not just the learning of the design process, but also subject matter and generic skills. Content learning, specifically mathematics and science learning, is evident in the process” (p. 13). She also suggested that the “game-building approach enables teachers to customize the experience to fit the unique needs of each classroom for any specific content” (p.13). This [game-building] process has also engaged students in the “real scientific method” (p.13), that is, “the messy process of iterative design, learning about systems, and subsequently modifying experiments” (Klopfer & Begel 2003, p. 25).

As the students built the digital games for others to use, Li (2010) also noted that they were engaged in systematic planning, critical analysis and collaborative learning, which enabled them to create and participate in affinity spaces, “sites of informal learning where ‘newbies and masters and everyone else’ interact around a ‘common endeavour’” (Gee, 2004, p. 85) to further their interests (Li, 2010, p. 13; Squire, 2008).

In their research with fifty ninth-grade, under-represented minority students designing GameMath, “a mathematics learning track for a new game making curriculum, Pedagogical
“Games” (p. 1), Shaw, Boehm, Penwala and Kim (2012) seemed to have encountered some difficulties in using the design and building of video games to teach mathematical concepts—Number System, Coordinate Geometry, Rates, Ratios & Proportional Relationships, Complex Rates, Statistics and Probability, Expressions & Equations, Creating Equations, and Reasoning with Equations & Inequalities. They reported that the challenges they encountered were myriad and included introducing math into the curriculum, designing authentic integration, dealing with computer distraction, and translating games skills to standards-based content and ultimately their application in a standards-based text context (p. 5).

They also explained that during the process, the students were initially creating their games “by rote and not really noticing the math they are using” (p. 6). They also encountered challenges in “formalizing problem solving within the domain” (p. 6) because the students were “more interested in creating the game rather than learning about the math” (p. 6). Initially, creating the game was “more important to foster engagement” (p. 6).

The teachers in Shaw et al.’s (2012) project reported that “student engagement in games was positive but sustaining interest was difficult and challenging” (p. 11). They felt that the “embedding of the math concepts into the game . . . still needed to be integrated in a better way, and game making should be independent of the mathematics” (p. 11). The teachers also noted that the math instruction that was integrated into the games, as opposed to math worksheets that were presented in front of the class was more engaging than paper-based individual instruction. Assessing students’ performance or progress was also a challenge because “students did not take assessments seriously” (p. 11) and they commented that the math was not necessarily easier when put into a game design context.

In their research with 67 seventh-graders in an interdisciplinary class, combining both science and computer science, Yang and Chang (2013) set out to investigate how “actively
involving students as designers and producers of digital games may have even greater potential for student empowerment through enhancing concentration and engagement, fostering higher order thinking, and improving learning outcomes” (p. 1). More specifically, they investigated the “impact of digital game authoring on students’ concentration, critical thinking skills, and academic achievement” (p. 1).

Their participants were divided into an experimental group (32 students designing digital games) and a comparison group (35 students designing Flash animations). The interdisciplinary approach involved integrating biology and computer programming classes. Students in the experimental group designed digital games based on biology course content, while the comparison group collaboratively produced Flash animations based on the same course content.

In their findings, Yang and Chang (2013) reported that using MANCOVA for pretest, post-test, and delayed post-test scores, the results from the experimental group demonstrated significant improvements in critical thinking skills and academic achievement with increased retention of the course content. They further reported that for concentration, although not statistically significant, there was a relative advantage for the experimental group compared to the comparison group. Based on the results of this study, implications for practitioners and researchers were provided and included the integration of programming or computer science with other courses for digital game authoring and the evaluation of other learning outcomes, such as creative thinking, problem-solving and flow.

According to these empirical findings, the design and building of digital video games seemed to enhance student active learning and understanding of subject content, their development of technological fluency skills, critical thinking skills, decision-making skills and new ways of thinking, in most instances. It also seemed to engage them in systematic planning, critical analysis and collaborative learning, in some cases.
However, findings also seemed to indicate that in some instances, the students were more interested in designing and building their games rather than learning the subject content, and tended to develop games in which the content was more extrinsically than intrinsically integrated. Generally, very little reference was made to teaching practice and assessment except in one study, and the references made were not very favorable.

In support of these observations, other researchers have recognized the potential of game design-based learning to enhance student learning (e.g., Felicia, 2011), while others are concerned about this type of approach for pedagogical usability and effectiveness, and the school context. For instance, Tzuo, Isabelle, Ling, Yang and Chen, (2012) have noted that “No matter how game design has been greatly developed in order to enhance students’ learning, its pedagogical usability to school implementations, including why, when, and how to use it is still ambiguous and not consolidated yet” (p. 420). They explained,

according to our practical experience in schools, while teachers credit game design-based learning especially for improved problem solving, thinking, and cooperative learning skills, they have difficulty tying it in with curricula. They raise concerns about the lack of holistic views that could align this kind of learning to the widely scoped teaching and learning demands of current schooling (p. 421).

Tzuo et al. (2012) also pointed out that

there is scant work on teacher-student interaction to guide teachers in whether they should provide scaffolding to students when students interact with computers in the context of [designing and building digital video] games. If they should, in turn, it is not clear what kind of guidance they have to provide (p. 425).

By referencing Masters and Yelland’s (2002) study with a similar teaching context, they recommended two aspects of scaffolding that teachers could use in the game design-based
learning context. One aspect deals with “cognition in assisting the students with concept
development in the process of creating stories” and the other is concerned with “group
management to ensure better group dynamics in the processes of brainstorming, discussion and
problem solving” (Tzuo et al., 2012, p. 427). Accordingly, they explained,

For concept development, teachers’ scaffolding strategies include the enforcement of
tasks, prompting for ideas, reviewing the current stage, and prospecting the next
movement with the students and narrowing the choices of ideas if students cannot decide
on one in the process of brainstorming. For group management, teachers’ scaffolding
strategies include defining the roles among each student and guiding students’ time
management (p. 427).

In terms of using the game design-based learning approach in the school context, there
has also been some concern about its effective adoption in the school context because of the
possible contextual and practical constraints of the school setting (Nielsen, 1994). This is
supported by Lim (2008) who argued that game-based learning or students as game designers
within traditional institutional frameworks will be ineffective because

computer games challenge the prevailing culture of schools where externally determined
knowledge is packed clearly for teachers to dispense to their students. If bringing games
into schools merely reproduce these power relations or knowledge transmission, it is
unlikely going to be any significant increase in learning engagement among students (p.
1002).

He suggested that fundamental changes are necessary for game development to truly
support student learning. Some of these changes include re-designing the curriculum to focus on
key questions, re-structuring timetables, and focusing on assessment for deep versus surface
learning instead of assessment for evaluation. Kafai (2005), however, has contended that the
classroom can become a “living laboratory providing educational researchers and practitioners with the opportunity to study pedagogical implementations in local contexts” (p. 28).

Based on the empirical findings of these documented studies and the views and concerns expressed by researchers on the design and building of digital video games, it is evident that further work needs to be done to address the concerns and to bring game design-based learning and “education communities closer together in order to build shared vocabularies and expectations, as well as to inform new learning and [pedagogical] designs to support effective game-based learning experiences” (de Freitas, 2006, p. 7).

The findings from the documented studies and researchers’ views and concerns had implications for this current research and were considered in the planning, implementation and design of the instructional and learning tasks’ activities, which guided students’/groups’ design and building of their video games. As a result, the findings from this current study appear to address some of the concerns and issues reported by previous researchers, as discussed in chapter 6.

The next chapter (3) describes the research methodology that was utilized to implement the design and building of digital video games in the local context, four grade 6 classes in a charter school in Calgary and address the questions that guide this design-based research study.
Chapter 3: Research Methodology

Philosophical Position of Research Study

Nicol (2003) noted that it is essential for researchers in the field of education to be clear about their philosophical position before embarking on their research designs. The philosophical position of the researcher must clearly show how the choice of methodology is compatible with the research questions being asked and the orientation of the research. The following research questions that guide this study require a methodology that translates ontological, and/or epistemological principles into guidelines that help to show how the research should be conducted (Sarantakos, 2005):

1. In what ways do teachers’ design of instruction and learning tasks need to shift when designing and building digital video games to intellectually engage students in deep learning of curriculum content and to develop and use 21st century competencies in school?

2. In what ways does the design and building of digital video games in school impact students’ intellectual engagement, deep learning of curriculum content and the development and use of 21st century competencies?

Therefore, based on these research questions, the methodology for this present research suggests an epistemological philosophical underpinning. Epistemology is concerned with how one comes to know about what exists (Barab, et al., 1999; Schuh & Barab, 2007).

Epistemological Perspective

There are two broad epistemological positions: positivism and interpretivism-constructivism. From an epistemological perspective, my research methodology draws from the interpretivism-constructivism position. The theoretical framework of the interpretivism-constructivism position
sees the world as one that is constructed, interpreted and experienced by individuals as they interact with each other and with wider social systems (Guba & Lincoln, 1985; Maxwell, 2006; Merriam, 1988). The epistemological positioning of this study indicates that the nature of inquiry is interpretive and its purpose is to understand a particular phenomenon, in this case the phenomena framed by the research questions (Farzanfar, 2005).

Positioned within this interpretivist-constructivist perspective, my research relies on an interaction between the researcher and the group participating during the data collection period (Klein & Myers, 1999). Therefore, building a partnership with the study participants should lead to deeper insight into the research process, while adding richness and depth to the data in answering the questions guiding the research study. As such, the methodology is more oriented towards discovery and process, less concerned with generalizability, and the research methodology is concerned with a deeper understanding of the effects of the research intervention in its unique context (Ulin, Robinson & Tolley, 2004). Therefore, in this research, findings are not generalized to a population, but mostly support and inform learning theory identification as opposed to development and refinement, and the process in creating artifacts and practices that will potentially impact learning and teaching in an attempt to positively impact educational practices (Tuli, 2010).

This research also places a strong emphasis on a better understanding of the world through firsthand experience, truthful reporting and quotations of actual conversation from the participants’ perspectives and experiences (Merriam, 1998). As the researcher, I employed multiple data gathering methods that are sensitive to the research context (Neuman, 2003), and which allow a “rich and detailed description of the phenomenon under study, by encouraging the participants to speak and act freely” (p. 100).
As is characteristic of the interpretivist-constructivist paradigm, issues of trustworthiness and credibility were key considerations in this research study. Lincoln and Guba (1985) suggested that for research to be considered credible and authentic, it should be based on a sound rationale that justifies the use of the chosen methodology and the processes involved in data collection and analysis.

**Research Design**

**Research Approach**

To answer the questions that guide this research study in addressing one of the main challenges faced by K-12 educators in some Canadian schools specified in the research, a design-based research (DBR) approach was employed. This research approach was employed because it tends to reflect the interpretivism-constructivism position within which this research study is philosophically situated. It is a methodological approach that is grounded in real-world contexts that allow participants to socially interact with each another within design settings rather than in laboratory settings, which are isolated from everyday practice (Collins, 1999). Design-based research or design experiments call for the cultivation of ongoing relationships between researchers and practitioners. “These relationships are sustained by the negotiation of a shared enterprise, which is typically developed over the long haul as lead researchers consistently demonstrate their personal commitment” (Cobb, Confrey, diSessa, Lehrer & Schauble, 2003, p. 12).

Design-based research is theory-driven and its advocates believe that, theory development is inextricably connected to practice (Brown & Campione, 1996) and dictates that both theory and practice should be refined by research (Collins, Joseph & Bielaczyc, 2004), while offering new possibilities. Wang and Hannafin (2005) noted that “the theory-driven nature of design-
based research is important in that its approaches are considered more a research paradigm than an evaluation method” (p. 9).

Design-based research is also characterized by continuous and iterative cycles of design, enactment or implementation, analysis, and redesign (Cobb, 2001). This allows for explanatory frameworks from previously conducted designs “that specif[y] expectations that become the focus of investigation during the next cycle of inquiry” (Cobb et al., 2003, p. 10). Using this iterative cycle, design-based research draws from a variety of methods including surveys, evaluations, case studies, interviews, inquiry methods and comparative analyses (Richey, Klein & Nelson, 2003). By utilizing “a combination of methods, data from multiple sources increase the objectivity, validity, and applicability of the ongoing research” (Wang & Hannafin, 2005, p. 10).

These characteristics of design-based research have implications for the design, development, and implementation of the intervention/the design and building of digital video games, as the researcher attempts to answer the questions that guide this research study. The characteristics of design-based research serve as a framework for combining and integrating research methods at different phases of the research (Squire, 2005).

Design-based research “calls for iterative cycles of study that lead to a better understanding of the process of intervention—process oriented” (Amiel & Reeves, 2008, p. 35). With the multi-phased and iterative nature of the intervention, such a framework can effectively help to refine or support theory and practice, as well as guide the collection and analysis of the data, while allowing the researcher to dig more deeply into the meanings of the data in an attempt to answer the questions that guide the research. As a unique enterprise, it is “a commitment to understanding learning and instruction in authentic contexts . . . and provides a useful framework
for studying learning in existing classrooms”, some of the underlying goals of this research study (Squire, 2005, p. 11).

**Description of the Research Context**

A description of the local context in which the intervention took place is critical to this research in order to inform other readers and researchers of the nature of the context for which this intervention was developed and implemented and how it worked in that context. Context, therefore, functions as a starting point in assessing the potential and effectiveness of the design and building of digital video games as an innovative pedagogy in the school context.

As in quality design-based research described by Anderson and Shattuck (2012), this research study was “situated in a real educational context” (p. 2) that is, a charter school, specifically, a community of four grade 6 classes involving two social studies teachers, their students (100) and one professional development leader, the co-participants of the research study. Locating this research in the classroom provided an authentic, complex context for the design and building of digital video games. Classroom-based research provides greater context validity to the research, while ensuring that its results can be effectively used to assess and inform innovative pedagogies that could intellectually engage students in deep learning of curriculum content and equip them with 21st century competencies in these, and possibly similar contexts.

**The charter school.** The charter school, the real educational context for the research, is one of Alberta’s 13 charter schools—“autonomous non-profit public schools designed to provide innovative or enhanced education programs that improve the acquisition of student skills, attitudes and knowledge in some measurable way” (Alberta Education, 2014, Education in Alberta is all about choice section, para. 1). The mission of this school community is to “Promote innovation and the ongoing development of exemplary learning, teaching and
leadership practices within an active inquiry-based learning community” (Policy 1.02, 2013).

The school’s mission is supported by several learning and teaching goals:

1. Promoting exemplary learning, teaching and leading through a disposition of inquiry;
2. Enhancing learning and teaching through the appropriate and effective use of technology and maintaining an intentional, authentic and innovative perspective in the use of technology;
3. Engaging students in meaningful, real-life learning activities in a variety of rich learning environments, with a focus on mind, body, emotions, creative spirit and ethical citizenship;
4. Providing environmental, outdoor and global education learning opportunities for students to experience and appreciate the world outside of the classroom and to develop social, leadership and stewardship skills;
5. Fostering a culture of collaboration and caring relationships of mutual respect with students, staff members and parents sharing a passion for learning, together and from others, in the classroom, within the school and beyond;
6. Nurturing thriving classrooms and other learning environments where teachers are informed by research and where students and teachers explore and develop deep understanding as active researchers (Charter School, 2014, Our Charter section, para. 1).

As described in the school’s Charter Document (2012-2027), these goals are promoted through Exemplary Teaching and Learning Frameworks. In these frameworks, teaching practice and learning involve:

- inquiry-based practice—learning is promoted through inquiry into real life experiences beyond the classroom;
• meaningful curriculum implementation—utilizing various teaching strategies to “bring the Alberta curriculum to life by planning engaging and authentic learning experiences, within and across subject areas, connecting to curricular outcomes” (p. 9) and making learning real, interesting and enjoyable;

• authentic assessment—various assessment strategies, including student self and peer assessments, are designed to “promote meaningful, ongoing and timely feedback to teachers, students, and parents” (p. 9) in order to foster excellence, promote success and encourage students to become self-directed learners;

• a culture of innovation—as “a community of innovators and risk-takers” (p. 9) that is, willingness to be creative and try new things or an entrepreneurial spirit, is promoted;

• a research focus—the development of a “deep understanding of the science of learning through inquiry and research [as] teachers actively use research to inform their teaching practice [and] encourage their students to join them as researchers in making meaning of their learning experiences” (p. 18) is increasingly emphasized;

• student success—embracing the diversity of students’ learning styles, interests and needs to develop their confidence, and ensuring that they achieve success through authentic student engagement, which is viewed as a key indicator of student success;

• a culture of collaboration exemplified through relationships—caring for each other and fostering a culture of mutual respect between students, staff, parents and other members of the school community; parents as partners—parents are allowed to become meaningfully involved in the education of their children; communication—“ongoing, varied and transparent communication with all members of the school community is provided, particularly, listening to, and honouring “the student voice” (p. 17); collaboration—formal and informal networks of collaboration within and beyond our
school are used to enhance teaching and learning; and professional development—
fostering the professional growth of teachers through “the intentional allocation of time
and resources leading to responsive, progressive, job-embedded and ongoing
professional development” (p. 17);

- technology-enhanced teaching—technology is used intentionally, authentically and
innovatively by the teachers to enhance learning and their practice in an inquiry-based
learning environment; technology is used as a tool to support students as “engaged
thinkers and ethical citizens with an entrepreneurial spirit” (p. 10); the school continues
to “explore the potential of new technology to communicate, learn, collaborate, solve
problems, make decisions, and create new knowledge in a variety of digital
environments and media” (p. 10).

The school’s teaching and learning frameworks provide a context for this research study
given that the intervention represents a way to possibly promote the culture of innovation, sustain
the reciprocal active research relationship between student learning and teaching practice and to
continue inquiring and exploring new or innovative and creative ways to ensure student success
through authentic student engagement in group projects.

**Physical context.** The physical context and environment for the research intervention
included two grade 6 classrooms in which the four grade 6 classes (6.1, 6.2, 6.3 and 6.4) were
held. Each class comprised the teacher and 25 students (15 males and 10 females) who were
divided into groups of fives, resulting in 20 groups being formed for the research intervention—
four homogenous groups of females, four homogenous groups of males and twelve mixed
groups. The rationale for using the homogenous and mixed groups was to set the stage for future
research into the impact that gender may have had on the findings of this current research.
Both classrooms were equipped with teaching and learning resources among which were movable desks, chairs, whiteboards, SMART boards, NEC projectors and screens, laptops for the teachers and iPads for the students. The iPads were provided to the grade 6 students as part of an iPad2 pilot project in which students were allowed to use the iPad as a learning tool within and outside the school. This iPad2 pilot project “reflects an emerging trend in the use of technology in the school” (Charter Document, 2012-2027, p. 10).

The physical context for the intervention was extended to include a small assigned space in the library (upstairs), on five iMacs. The additional space in the library was set up by the teacher participants, in collaboration with the professional development leader, to accommodate the actual building of students’/groups’ video games during the programming task. This space within which the iMacs were located was very limited and could not accommodate 5 groups (25 students) in any one session. As a result, in the first six sessions of the programming task, five programmers from each of two classes, were, simultaneously, allowed to use this space to program their games in 35-minute sessions.

At the beginning of June 2014, a set of reserved laptops from the library were also provided to the programmers in all the groups to increase the amount of time available for the building of their games. To accommodate the increased number of computers and programmers per session, more library space was assigned for the programming task. As such, the increased space was also able to accommodate more group members as they worked and collaborated with the programmers.
Scratch—game software.

Scratch (see Appendix C for features of software in YouTube videos), a programming language designed and managed by the Lifelong Kindergarten group at the Massachusetts Institute of Technology (MIT) Media Lab was chosen by the researcher and presented to the teacher participants as the game software for the students/groups to build their games. Scratch was chosen for this research intervention because, as described by two of its developers, it is a “programming language that makes it really easy to create . . . interactive stories, music, games, art and animations . . . and used across disciplines” (Brennan, 2011, ScratchEd Webinar), it represents a “four-dimensional design-based approach to learning—learning through design, learning through interests, learning through collaboration and learning through reflection” (Resnick, 2011, ScratchEd Webinar), which mirror aspects of the current research that will be analyzed in an attempt to address the research questions, is easily accessible on the Internet and free to use (no license needed).

In his description of learning through design, Resnick (2011) stipulates that this type of learning draws upon the ideas of Piaget (1957) about children as active constructors of their knowledge and Papert (1980) who extended on this idea with his observation that new ideas can be constructed when children are actively constructing new things in the world. Learning through design is seen as a way that learners, including children, are likely to make “new ideas when they are actively engaged in making some type of external artifact—be it a robot, a poem, a sand castle, a computer program” (ScratchEd Webinar) or a video game.
In his description of learning through interests, Resnick (2011) stipulates that over the years, it has become evident that “the best learning experiences have been where people are really engaged in the process [and when], they’re working on things they really care about” (ScratchEd Webinar). As a result, to allow everyone to work on projects in Scratch that they really cared about, it was designed with a “low floor—easy to get started, a high ceiling—opportunities to create increasingly complex projects over time, [and] wide walls—supporting many different types of projects so people with many different interests and learning styles can all become engaged” (Resnick, et al., 2009, p. 63).

In her description of learning through collaboration, Brennan (2011) explains that “everything we know about creativity, everything we know about the nature of learning, is that it’s integrated in the social” and that “the best learning experience takes place when [there is] access to others to exchange ideas and inspire another” (ScratchEd Webinar). She also added that during this design-based approach to learning in Scratch, learners can become so busy and engaged in the activity of building things, synonymous to the concept of flow in intellectual engagement, that they don’t have the time and opportunity to step back and reflect on what they’re doing. Brennan (2011) argues that learning through reflection is very important to the design process because it helps to “identify what we know and what we need to know in terms of developing as designers” (ScratchEd Webinar). Therefore, we need to find ways of reflecting while using Scratch. In this research study, reflections were continuously used through discussions, Socratic dialogues, instructional conversations, blogging, self and peer assessments to promote student learning and understanding as they designed and built their video games.

To emphasize the effectiveness of Scratch in its contribution to learning, Rusk, Resnick and Maloney (n.d.), describe Scratch as a platform that also supports the development of nine types of 21st century learning skills identified by the Partnership for the 21st Century: information
and media literacy skills; communication skills; critical thinking and systems thinking; problem identification, formulation & solution; creativity and intellectual curiosity; interpersonal and collaborative skills; self-direction; accountability and adaptability; and social responsibility, all of which contributed to the analysis of the ways in which the intervention impacted the students’ development of 21st century competencies.

The effectiveness of Scratch for this research intervention is further supported by its ability to help kids learn to code, because, as Resnick (2012) explains, when you learn through coding and coding to learn, you’re learning in a meaningful context and that’s the best way of learning things. As kids work on . . . projects and create . . . scripts, they are also learning about the process of design—how to start with a glimmer of an idea and turn it into a fully-fledged functioning project. They could learn the core principles of design and how to experiment with new ideas, how to take complex ideas and break them down into simpler parts, how to collaborate with other people on [their] projects, how to find and fix bugs when things go wrong, how to keep persistent and to persevere in the face of frustration when things aren’t working well (Video file).

To initiate students’ use of Scratch, the teacher participants, in collaboration with the professional development leader, helped each of the groups to create a Scratch account in their programmers’ names on the MIT Scratch website in which they would build their games. Building games using the iMacs versus the iPads seemed necessary in the beginning of the project because Scratch only seemed to be available as a desktop application—it runs on laptops and desktop computers. However, with some research, the professional development leader eventually discovered an app that could help students download Scratch on their iPads by paying a small fee. At the time this solution was found, the programmers in all the groups chose to
continue using the iMacs to build the games because the Scratch version on the iPads posed some challenges when manipulating the Scratch elements.

Further, the larger monitor space on the iMacs was far more generous for this activity than the screen space available on the iPads. After the accounts were created and accessible, all students were able to access the Scratch training videos downloaded from YouTube (see Appendix C) that the researcher provided to the teacher participants. The videos served as useful resources for the students to learn and use Scratch before and during the implementation of the programming task.

**Actual time-tabled sessions.** The teacher participants and researcher collaboratively scheduled weekly sessions for the implementation of each task during the prototyping phase of the design-based research process—planning, game concept development, storyboarding and programming. However, the flexibility of the school’s activities and internal difficulties setting up hardware resulted in the modification of some of our planned schedules. For instance, sessions had to be cancelled or dates changed to accommodate the tasks’ activities. The actual number of time-tabled sessions held for each task is presented in Tables (4-7). Each table represents a detailed account of the activities designed and implemented in each task in mostly one-hour sessions according to scheduled dates. These activities were based on a designed framework (see Table 10) collaboratively constructed by teachers and researcher to guide the implementation of the tasks in the prototyping phase of the process. A detailed discussion of their implementation is presented in Chapter 4.
Table 4

**Time-tabled Sessions for Planning Task**

<table>
<thead>
<tr>
<th>Date</th>
<th>Sessions</th>
<th>Session Activity</th>
<th>Duration per Session</th>
</tr>
</thead>
<tbody>
<tr>
<td>August, 2013</td>
<td>2</td>
<td>Presented problem and proposed research-informed design solution to the problem, to teachers; identified the curriculum content for the intervention and learning and intervention goals to be achieved; discussed duration of intervention; presented Scratch game software for consideration; discussed and finalized date for carrying out Learner Profile and Video Game Experience surveys; distributed educator and parent/child consent forms to teachers and students</td>
<td>1hr</td>
</tr>
<tr>
<td>20, 21</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>September, 2013</td>
<td>2</td>
<td>Presented and discussed with teachers (i) a review of the literature on game design-based learning to understand and contextualize the problem and some literature on design-based research methodology for their information; (ii) a theoretical framework for the design and implementation of the intervention in the prototyping of the design-based research process; (iii) research questions to guide the study; (iv) the classroom observational protocols to guide the researcher’s observation during the learning tasks; hardware for the implementation of the learning tasks discussed; dates for surveys finalized; dates for pre-interviews finalized; initial duration for the intervention finalized—November 5, 2013-March 31, 2014</td>
<td>1hr</td>
</tr>
<tr>
<td>17, 18</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19, 20</td>
<td>2</td>
<td>Completed child assent forms with grade 6 classes</td>
<td>1hr</td>
</tr>
<tr>
<td>24</td>
<td>1</td>
<td>Carried out learner Profile and Video Game Experience surveys with grades 6.1 and 6.3</td>
<td>1hr</td>
</tr>
<tr>
<td>25</td>
<td>1</td>
<td>Carried out learner Profile and Video Game Experience surveys with grades 6.2 and 6.4</td>
<td>1hr</td>
</tr>
</tbody>
</table>

(table continues)
<table>
<thead>
<tr>
<th>Date/August, 2013</th>
<th>Sessions</th>
<th>Session Activity</th>
<th>Duration per Session</th>
</tr>
</thead>
<tbody>
<tr>
<td>October, 2013</td>
<td>2</td>
<td>Carried out pre-interviews with groups from grades 6.1 and 6.3</td>
<td>1hr</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>Carried out pre-interviews with grades 6.1 and 6.3 teacher</td>
<td>1hr</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>Carried out pre-interviews with groups from grades 6.2 and 6.4</td>
<td>1hr</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>Carried out pre-interviews with grades 6.2 and 6.4 teacher</td>
<td>1hr</td>
</tr>
<tr>
<td></td>
<td>29</td>
<td>Chose and presented game software, Scratch, to teachers and provided teacher participants with training modules for Scratch</td>
<td>30 mins</td>
</tr>
<tr>
<td>November, 2013</td>
<td>Matt</td>
<td>Dave</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>1</td>
<td>Scratch training</td>
</tr>
<tr>
<td></td>
<td>19</td>
<td>1</td>
<td>Scratch training</td>
</tr>
<tr>
<td></td>
<td>20</td>
<td>1</td>
<td>Scratch training</td>
</tr>
<tr>
<td>December, 2013</td>
<td>3</td>
<td>1</td>
<td>Scratch training; finalized game-design and building teams/groups (story writer, artist, programmer, musician, leader) for each class</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>1</td>
<td>Scratch training</td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>1</td>
<td>Scratch training</td>
</tr>
<tr>
<td></td>
<td>13</td>
<td>1</td>
<td>Scratch training</td>
</tr>
</tbody>
</table>
Table 5

Time-tabled Sessions for Game Concept Development Task

<table>
<thead>
<tr>
<th>Date/March, 2014</th>
<th>Morning Session 9:20-10:20 a.m.</th>
<th>Afternoon Session 1:00-2:00 p.m.</th>
<th>Session Activity</th>
<th>Duration per Session/hr</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>1</td>
<td>2</td>
<td>Groups chose topics (decision-making method: consensus, representative democracy, majority and plurality voting) and historical model of decision making: Ancient Athens, Iroquois Confederacy and Municipal and Provincial [current era or modern day]; guiding questions developed for research on topic</td>
<td>1 hr</td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td>4</td>
<td>Group performance assessed (self and peer reflect on performance and progress within the group guided by four attributes: Cooperation, Contribution, Communication and Collaboration—Self-Reflect Rubric)</td>
<td>1 hr</td>
</tr>
<tr>
<td>10</td>
<td>5</td>
<td>6</td>
<td>Groups re-focussed on developing their guiding questions to inform the research of the chosen topics</td>
<td>1 hr</td>
</tr>
<tr>
<td>12</td>
<td>7</td>
<td>8</td>
<td>Groups refined guiding questions; commenced research and brainstormed storyline ideas for game concepts</td>
<td>1 hr</td>
</tr>
<tr>
<td>14</td>
<td>9</td>
<td>10</td>
<td>Groups brainstormed storyline ideas; re-formulated guiding questions based on storyline and carried out research guided by questions; formative assessments/feedback carried out by teachers—green, yellow, red lights</td>
<td>1 hr</td>
</tr>
<tr>
<td>18</td>
<td>11</td>
<td>12</td>
<td>Groups developed and refined game concepts informed by research and feedback from formative assessment</td>
<td>1 hr</td>
</tr>
<tr>
<td>20</td>
<td>13</td>
<td>14</td>
<td>Approval of all game concepts—green lights</td>
<td>1 hr</td>
</tr>
</tbody>
</table>
### Table 6

**Time-tabled Sessions for Storyboarding Task**

<table>
<thead>
<tr>
<th>Date/ April, 2014</th>
<th>Morning Session 9:20-10:20 a.m.</th>
<th>Afternoon Session 1:00-2:00 p.m.</th>
<th>Session Activity</th>
<th>Duration per Session/hr</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>1</td>
<td>2</td>
<td>Teachers defined storyboarding in video game design and provided examples to students in 15-minute teaching moment; Groups began brainstorming storyboard ideas</td>
<td>1 hr</td>
</tr>
<tr>
<td>8</td>
<td>3</td>
<td>4</td>
<td>Groups brainstormed storyboard ideas</td>
<td>1 hr</td>
</tr>
<tr>
<td>10</td>
<td>5</td>
<td>6</td>
<td>Groups designed and created storyboards; groups collaborated using assigned roles; switching of roles in some groups</td>
<td>1 hr</td>
</tr>
<tr>
<td>14</td>
<td>7</td>
<td>8</td>
<td>Groups continued creation of storyboards; groups presented storyboards to teachers for formative assessment/feedback—green, yellow, red lights; groups refined storyboards</td>
<td>1 hr</td>
</tr>
<tr>
<td>16</td>
<td>9</td>
<td>10</td>
<td>Teachers provided guided instruction to include the curriculum content in storyboards; groups continued creation of storyboards; groups presented storyboards to teachers for formative assessment/feedback—green, yellow, red lights; groups continued to refine storyboards</td>
<td>1 hr</td>
</tr>
<tr>
<td>22</td>
<td>11</td>
<td>12</td>
<td>Individual group members engaged in Elevator pitches/self assessment</td>
<td>1 hr</td>
</tr>
<tr>
<td>24</td>
<td>13</td>
<td>14</td>
<td>teachers provide feedback on elevator pitches; teachers provide formative assessment/feedback—green, yellow, red lights; groups refined storyboards</td>
<td>1 hr</td>
</tr>
<tr>
<td>28</td>
<td>15</td>
<td>16</td>
<td>Group engaged in share reflections/group/peer assessment; teachers provide further formative assessment/feedback—green, yellow, red lights</td>
<td>1 hr</td>
</tr>
<tr>
<td>30</td>
<td>17</td>
<td>18</td>
<td>Teachers provide further formative assessment/feedback—green, yellow, red lights; groups refined storyboards based on feedback from teachers and groups; completion of storyboards—green lights</td>
<td>1 hr</td>
</tr>
<tr>
<td>Roles</td>
<td>Session Activity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>------------------</td>
<td>------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Programmers</strong></td>
<td>Guided by game aspects or game design principles, designed and drew, coded and scripted appealing visuals, e.g., title screen, navigation buttons, backgrounds, the characters and a bit on costume switching algorithms to generate the appearance of walking/running or animating characters, and more costumes; scripted and coded the dialogues; modified or made changes and refined game prototypes based on testing and peer feedback and ensuring that goals and objectives that the player had to accomplish and game rules were clear, increased levels of difficulty to challenge the players were evident with feedback cycles and a reward system, the game was appropriate for their target players’ skills level, easy to use so, the players were motivated and game was fun to play; fixed glitches manually; fixed glitches using glitching apps</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Story writers</strong></td>
<td>Developed dialogues for each scene; named the characters; developed questions for the dialogues; helped the programmer script and code the dialogues for the right characters</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Artists</strong></td>
<td>Drew and created setting, screen backgrounds using freehand and pixel art; drew and created backdrops, maps, characters for the game, menu, start and restart buttons using sketchbook express, helped the programmer to draw all the buttons, backdrops and characters and to upload the backgrounds</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>**Musicians/</td>
<td>Created the introduction or title screen music to catch the players attention; created an end of game song to set the mood for the ending; created some music that sounded like it would be used in the Iroquois community; created music in GarageBand (drums) and tabletop and tried to find different apps to create sounds, funk and old music; recorded group members playing the flute; recorded group members making sounds; created noises that seemed to sound close to those in Athens and Iroquois communities; created music for each scene and the credits; created music for the walking to the longhouse scene; helped the programmer to upload sounds and music for the scenes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Sound Engineers</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Leaders</strong></td>
<td>Ensured that everyone in the group had something to do and remained on task; helped the artist to work on the characters and backgrounds; helped the musician create and test the music for the scenes</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**Participants.** Guided by one of the main principles of design-based research, all participants immersed in the research setting worked as collaborators during the implementation of the learning tasks in the prototyping phase of the design-based research process (Wang & Hannafin, 2005). Any decisions that needed to be made to further refine or modify this implementation was made with the collaboration or consultation of the participants, who in this research context “are not ‘subjects’ assigned to treatments but instead are treated as co-participants in both the design and even the analysis” (Barab & Squire, 2004, p. 3).

The participants in this research study included two practitioners/teachers, their students (100) and the professional development leader. These teachers did not have to be familiar with the design and building of digital video games, but needed to be willing to explore new technologies as innovative pedagogies that could address the problem that initiated this present research study, as well as other challenges to their present teaching practices. Their students did not have to be familiar with video-gaming and could include players, builders, non-players and non-builders.

In this research study, the researcher, classroom practitioners/teachers and their students (100), as well as the professional development leader, all formed the research design team. All members of that team functioned as learners who created and evaluated knowledge and skills in the context of the study. The research design team could also include a larger community of learners, such as other teachers, students, parents, the school principal, vice principal and my research supervisor for whom this research had some impact. The brief descriptions that follow are meant to describe how the classroom teacher co-participants were obtained, and to provide an introduction to all the participants of the study. In introducing the teacher co-participants, pseudonyms were used to protect their anonymity.
Obtaining the co-participants. To obtain the co-participants for this research study, I initially made contact with the vice principal of the charter school in February, 2012, asking him for his assistance in identifying teachers who may be interested in the study, a method known as snowball-sampling (Merriam, 1998). Two of the teachers (a grade 7 humanities or social studies teacher and a grade 9 math teacher) expressed immediate interest. The vice principal also recommended that I meet and speak with the video game design instructor, a grade 9 teacher, and the professional development leader at the school because of the nature of the study. I scheduled an initial meeting with the three teachers and the professional development leader in February 2012 to introduce myself and to explain the goals and process of the research study. Upon confirmation of their interest to participate in the research study, we all agreed to meet again after I had obtained ethical approval from the University of Calgary Conjoint Faculties Research Ethics Board to carry out this research.

By October 2012, I had learned that the grade 9 math teacher had moved to another province, the grade 7 humanities teacher had assumed the role of professional development leader and the previous professional development leader had assumed the role of a grade 5 teacher. On contacting the present professional development leader, he assisted me in recruiting other teachers to participate in the study. He distributed another letter from me about the research to the teacher population. Three teachers (two grade 7 humanities or social studies teachers and a grade 9 math teacher) along with the professional development leader expressed interest in participating in the study. However, because of a decision to limit the scope of the research to one grade level, I arranged to hold an initial meeting with the two grade 7 teachers in January 2013, to introduce myself and to briefly explain the goals and process of the research study. We agreed to start the research in March 2013 and to reconnect after ethical approval had been obtained to carry out the research.
Obtaining ethical approval for the research took longer than expected and extended the study period by at least six months (see section on Ethical Considerations for details on ethical review and approval process that resulted in this extension). As a result of the lengthy ethical review and approval process, the initial start date, March 2013, had to be re-scheduled to September 2013. By then, the two grade 7 social studies teachers were re-assigned to grade 6. Therefore, I formally re-invited these two grade 6 social studies teachers with their students, and the professional development leader, who is also an expert in video games, to participate in this design-based research study.

**Meet the co-participants.** Matt is a grade 6 social studies teacher and at the time of the study had been teaching social studies for 16 years. During the intervention, he taught social studies to two of the four grade 6 classes (50 students). While he had no experience in playing and building video games, Matt was willing to explore the design and building of digital video games as a new pedagogy or strategy to teach social studies to his grade 6 students. Accordingly, he stated,

> I want to see them deepening their understanding of social studies’ issues, history and current events and use a video game platform to deepen that understanding. So that will be what I keep my focus on. While they can become distracted with the details of the video game, I’m going to keep in my own mind, where are we going with this? Is this helping to deepen their understanding? We don’t want a task just for the task’s sake. We want to see if it’s going to work at deepening their understanding of social studies within the classroom setting. It should be interesting (Pre-interview, October 2013).

Matt further stated that his philosophy in helping students to understand what they were learning was to

> go deeper, don’t go broad . . . [and when] looking at social studies issues, it’s about reinforcing their ability to see an issue critically, and to make strong
inferences about what’s really going on here... It’s not on how many facts they’ve come to learn, but when they are deeply engaged in an issue, the facts just come along (Pre-interview, October 2013).

When questioned as to how he was going to utilize this strategy with no experience in playing and/or building video games, he stated,

I don’t as of yet have too much of a picture of how it’s going to work, so I’m going to do my best to remain open-minded. I don’t think I need to be a master of the craft. I think these children will be very engaged. So I would rather, instead of me guiding them along the way, I’d like to give them the opportunity to pursue it on their own, knowing what they do know, and then I’ll just sort of be there to give them that push if they need it. It will be definitely something new for me. This strategy is going to be more student-centred than teacher-centred because I don’t have an end in mind. It’s an open process in my mind right now (Pre-interview, October 2013).

Dave is also a grade 6 social studies teacher and at the time of the study had been teaching social studies for 3 years. During the intervention, he taught social studies to two of the four grade 6 classes (50 students). With some experience in playing video games and no experience in building video games, Dave was also willing to explore the design and building of video games as a new pedagogy or strategy to teach social studies to his grade 6 students. He stated that this experience would be interesting because he thought that it would be “a good way for students to show their mastery of the subject” (Pre-interview, October 2013).

He also felt that since games were a big part of the students’ lives, it would allow Matt and him to use this video game design and building approach to their advantage in sponsoring learning in social studies and to see how well it would work. He also anticipated that “actually designing and building games that are meant to explore certain areas in social studies... shows a
different level of understanding and a more complete level of understanding” (Pre-interview, October 2013).

Thomas, a professional development leader in the school, is a former grade 7 social studies teacher with some experience in playing and building video games. His main role in this research intervention was to provide his video game expertise, when needed, and technical assistance/support to Matt, Dave and their students.

The students (100) who participated in this research intervention are grade 6 students (10-11 year olds). An interesting result from the survey on student experience in playing and/or building video games (see Appendix D) was that 97 of the 100 student participants had played various video games, including Minecraft, Injustice, Call of Duty: Black Ops, League of Legends, Halo, Sims 3, to name a few, for at least 3 hours a week. Twenty-one (21) of the students indicated that they had some experience building video games, mostly using game software such as SketchNation. Of the 97 who indicated that they play video games, 59 were males and 38 females. Of the 21 who indicated that they build video games, 17 were males and 4 females. The following Figures (3, 4 and 5) represent a distribution of the players and builders according to the four grade 6 classes by gender:

![Grade 6 Students' Experience Playing vs Building Video Games](chart)

*Figure 3. Grade 6 students’ experience playing vs building video games*
In describing the students, one of the teachers, Matt, stated that the students were all “very eager, interested and hopeful . . . and they want to do well”. They also have become really good at critical thinking and self-reflect on their own learning” (Pre-interview, October 2013), which he thought was something to appreciate because it allowed the class to move forward in a more positive way and were able to tell them (teachers) if something was not working for them (Pre-interview, October 2013).

In alignment with a description of today’s students by many researchers (e.g., Brown, 2000; Jenkins, Purushotma, Clinton, Weigel & Robison, 2006; Junco & Mastrodicasa, 2007;
Oblinger & Oblinger, 2005a; Parsons & Taylor, 2011; Tapscott, 2009), almost all of the students described themselves as ‘hands-on and engaged learners’ who prefer to learn with technology and through projects. Students’ responses on how they prefer to learn are captured in the following examples, across classes:

**Boy TN (6.1):** I like learning hands-on and moving around a lot because it helps me learn more and it doesn’t just go in one ear and out the other.

**Boy KE (6.1):** I want to be in all of it. I don’t want to be watching or reading from something that someone else did. I like being a person doing the work.

**Boy DX (6.2):** Everything that is not hands-on I forget within the next week.

**Girl SN (6.2):** The way I like to learn is visually and kind of artistic.

**Girl PC (6.2):** I like learning with projects better. You don’t dread the coming of a project, but you might dread the coming of a test. With a project, you can’t fail, you just have to show them what you know.

**Girl SO (6.3):** I like to learn with projects because usually most schools they learn by doing tests, but usually you study and study and study and then there’s just this little test and you forget everything. I enjoy working with projects instead of tests.

**Girl RG (6.4):** I want my learning to be engaging and not just like the teacher telling us stuff. I want us to like actually do things that help us understand the concept that we’re learning.

**Boy CN (6.4):** I like using technology when I learn.

**Boy UR (6.4):** I like working with all types of technologies (Pre-interview, October 2013).

Results from the My Learner Profile Survey (see Appendix E), administered prior to the implementation of the learning tasks, helps to describe the students’ interests and abilities. Findings from the survey revealed that 47 of the students were interested and skilled in writing stories (19 males and 28 females); 36 in creating music (23 males and 13 females); 21 in programming or coding games (17 males and 4 females); and 55 in artwork (31 males and 24
females). Within this distribution, some of the students seemed to be multi-skilled, that is, students were proficient in more than one of these skills.

For example, 17 of the students indicated that they were interested and skilled in writing stories and creating music; 7 in creating music and programming or coding games; 13 in programming or coding games and artwork; 12 in writing stories and artwork; and 22 seemed interested and multi-skilled or proficient in more than 2 of these skills. Overall, a majority of the students seemed to be interested and skilled in artwork and writing stories, while the least number of students seemed to be interested and skilled in programming or coding games, corroborating the results in the video game experience survey on their experience in designing and building video games.

In the Learner Profile survey, 28 student participants indicated that they spent a lot time blogging and chatting online; 85 students indicated that they enjoyed designing and building things; 52 discarded printed directions and figured out how to build things on their own; 58 liked to solve problems in real life situations; and 50 liked taking leadership roles in groups. Overall, these results seemed to indicate that a majority of the students enjoyed designing and building things, while a minority of students spent time blogging and chatting online.

When questioned during the pre-interview about designing and building video games to learn in school, the students seemed very excited about the idea. In response to the question, “How would you feel about designing and building digital video games to learn certain concepts in your social studies class?”, some of the students, across classes, commented as follows:

**Boy GT (6.1):** With using the building of video games to learn, I think it will be a really cool experience. I’ve never even thought of the idea so I think it’ll be really cool to try.

**Boy TN (6.1):** That would be really awesome if we could learn that way cause I’ve never done it that way before and so I think it would be more fun.
Girl DB (6.2): Learning with building games would be like a really cool experience, cuz I’ve never learnt with video games, so yea, it would be quite awesome. I think it will be a fun way to learn instead of having to sit there and work on paper like assignments. Making games would be awesome.

Boy YO (6.2): I know most people aren’t exactly excited about learning about social studies but a lot of people like video games. So it’s a good way to catch the interest of most kids cuz some kids don’t like learning a lot.

Girl LR (6.3): I think that’s a pretty good idea because while you’re learning, you’re also doing something else to help you learn, so that will actually be really good.

Boy SK (6.3): I think it would be great because with me, personally, I get really intrigued by video games and I really like following the storyline in video games. So if the storyline in the video game is studying the Aztecs, then boom, I know the history of an Aztec.

Boy UR (6.4): I think it would be really fun because I’ve programmed video games several times and I really liked it. It was quite fun doing that.

Girl EF (6.4): I just think it will be fun to create one and learn at the same time because when you are having fun. You really don’t notice that you are learning anything but you really are learning a lot (Pre-interview, October 2013).

Researcher: As researcher, I also embraced the roles of designer, facilitator and observer in order to collect authentic and naturalistic data from the teachers and student participants and to avoid bringing attention to myself as just a researcher (Stoddart, 1986). As a designer and facilitator, I collaborated with the teachers during (a) the planning task to facilitate and construct/develop (i) a framework/model for the design and implementation of the tasks that guided the design and building of students’/groups’ video games; (ii) the learning environment—created the groups and assigned roles within which the students needed to participate in the learning tasks, chose the game software/Scratch that the teachers and students used to build the games, organized students’ and teachers’ training in their use of the game software/Scratch and provided resources for the training sessions, teachers’ instructional activities, learning tasks’
activities and a scheduled time-frame for the implementation of the learning tasks; (iii) the design principles that teachers needed to guide the design of the learning tasks’ activities; (iv) the design principles needed to guide the design and building of the games (educational gaming, learning and technical aspects); and (b) the learning tasks to continuously contribute to discussions with the teachers on the decisions that needed to be made in carrying out the changes/modifications or iterations of each learning task.

As an observer, I closely observed and documented my observations of the teachers’ design of instructional and learning tasks’ activities, students’ intellectual engagement, deep learning of how the citizens in students’/groups’ various models participated in the government decision-making process and development and use of 21st century competencies guided by four classroom observation protocols. I also closely observed and documented the complexities and challenges being encountered by the teachers and the students/groups during the implementation of the learning tasks.

Procedures for Data Collection

Design-based research interventions are assessed using multiple methodologies (Anderson & Shattuck, 2012). However, as stated by Fraenkel and Wallen (2009) because of the pragmatic nature of design-based research, a design-based researcher “should use whatever works” (p. 559). Therefore, guided by the principle of design-based research with regards to the implementation of research methods, that is, the research methods should be implemented systematically and purposefully (Wang & Hannafin, 2005), and based on the advice of MacDonald (2008) who stated that design-based research “pragmatically employs qualitative [and/]or quantitative research methods that are congruent with the research questions” (p. 430), I employed a mixed methods design to address the questions that guided this research study.
More specifically, based on Creswell’s (2013) categorization of the basic types of mixed methods designs, I employed an adapted form of the embedded design (see Figure 6) to collect the data in this study. Quantitative and qualitative data were collected sequentially, before, during and after the prototyping phase, and analyzed, systematically and continuously, to inform/address the implementation and iterations of the learning tasks and the research questions.

Figure 6. Adapted embedded design from Creswell’s (2013) mixed methods designs employed to collect the data

Specifically, before the implementation of the learning tasks (game concept development, storyboarding, programming), priority was given to the collection and analysis of quantitative data—online surveys (primary form of data) supported by qualitative data collection and analysis—pre-interview. As described later on, this informed the formal training sessions needed for the game software/Scratch, the formation of the student groups for participation in the learning tasks and researcher knowledge of teachers and students’ teaching and learning experiences before the implementation of the learning tasks.

During and after the implementation of the learning tasks, priority was given to the collection and analysis of qualitative data (primary form of data) supported by the collection and
analysis of quantitative data emanating from the qualitative data. This sequential form of data collection and analysis aimed to collect multiple sources of information that were congruent with the research questions.

This information would also more accurately help to assess/evaluate the potential and effectiveness of the design and building of digital video games as an innovative pedagogy to intellectually engage students in the deep learning of the government decision-making process and promote the development and use of 21st century competencies. As such, Table 8 shows how data collection methods and sources were matched to the research questions to obtain this information.

Table 8

Data Collection Methods and Sources Matched to Research Questions

<table>
<thead>
<tr>
<th>Research Questions</th>
<th>Data Collection Methods</th>
<th>Data Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>In what ways do teachers’ design of instruction and learning tasks need to shift when designing and building digital video games to intellectually engage students in deep learning of curriculum content and to develop and use 21st century competencies in school?</td>
<td>Direct observation informed by observation protocols for teacher instructional activities, deep learning, intellectual engagement and development of 21st century competencies</td>
<td>Teachers’ documents (game design unit plan, assessment rubrics, feedback)</td>
</tr>
</tbody>
</table>
| In what ways does the design and building of digital video games in school impact students’ intellectual engagement, deep learning of curriculum content and the development and use of 21st century competencies? | Interviews (pre-, mid-, post) | - Teaching moments  
- Teachers’ blog  
- Kidblogs  
- Students’ Google Documents  
- Transcribed audio conversations and discussions  
- Formative assessments  
- Students’ self and peer assessments  
- Video-taped group activities  
- Students’ game artifacts (game concepts, storyboards, game prototypes) |

As Sandoval (2011) noted, the methods that one would use to document data throughout the study would change and I did experience this change as the learning tasks were being implemented. I employed what Johnson and Turner (2003) referred to as inter-method mixing. I
began with direct observation informed by the four observation protocols, but needed to utilize interviews (mid-, post) to confirm and explain the data being collected and analyzed from the observation protocols. Various data sources, for example, teachers’ documents (game unit plan, assessment rubrics, feedback), Teacher-researcher artifact (framework for the design and implementation of the intervention in the prototyping phase of the design-based research process), kidblogs and students’ game artifacts (game concepts, storyboards, game prototypes) were also used to confirm and explain the data being collected and analyzed from the observation protocols and interviews.

Multiple data collection methods (Anderson & Shattuck, 2012) implemented systematically and purposefully helped to diminish the possibility that one perspective would shape or determine the outcomes of the exploration (Stringer, 2008). Making use of a variety of data sources also helps the researcher to “validate and crosscheck findings” (Patton, 1990, p. 244) for greater reliability, “the extent to which research produces the same results when replicated” (Bloor & Wood, 2006, p. 147). This is supported by other researchers (Akilli, 2008; Design-Based Research Collective, 2003; Dix, 2007; O’Donnell, 2004; Stringer, 2008; Wang & Hannafin, 2005), who also add that using multiple sources of data helps to diminish the possibility of bias, promote more objectivity and reliability in the findings, which is difficult to achieve in design-based research.

The challenge for design-based researchers to achieve objectivity in a study exists because researchers who are “conducting design-based research usually, if not always, need to immerse themselves in the research context and intensely interact with participants. As a consequence, it is difficult to keep being objective and neutral” (Instructional Technology Ph. D Students at the University of Georgia, 2006c, Credibility of data section, para. 2). Therefore, the triangulation of multiple sources and types of data was purposeful and intentional in order to
maintain and increase the objectivity of the findings, contribute to improved reliability of the findings, as well as address possible bias and add depth and increase rigor to the research process.

**Quantitative methods.** The main quantitative methods used were two online surveys, which were carried out with the teachers and students. The Video Game Experience survey (see Appendix D) was developed by the researcher and conducted with all teacher and student participants to find out the number of participants with or without previous knowledge and skills in the playing and building of digital video games. The My Learner Profile survey (see Appendix E) was also developed by the researcher and conducted with only the student participants to obtain information on students’ learning interests, expertise and social skills. The findings from these surveys (see Appendices D and E) informed the Scratch training and practice provided to the students and teachers to help them acquire pre-requisite knowledge and skills in Scratch and the formation of the working groups for the design and building of the video games.

**Qualitative methods.** Multiple methods that were utilized to collect and analyze qualitative data included (i) direct observation (informed by four observation protocols); (ii) interviews (pre-, mid-, post); (iii) data sources (teachers’ documents, teacher-researcher artifact, kidblogs and students’ game artifacts).

**Direct observation.** According to Alkin (2011), In carrying out observations, the central idea is to “systematically engage in this careful watching until such time that you notice continuing patterns or trends. You want to understand what is happening in as much detail as possible – as you are seeing it take place” (p. 111). As such, I used a direct observation method informed by classroom observation protocols for teacher instructional activities, deep learning, intellectual engagement, and 21st century competencies (as seen in Appendix F). Copies of these observation protocols were brought on site, for each session, to observe, monitor, systematically document and analyze the teachers’ and students’ experiences—behaviors, acts or events that
would help to provide evidence of (i) teachers’ design of their instruction and learning tasks as they implemented the learning tasks’ activities; and (ii) the impact of the learning tasks’ activities on students’ intellectual engagement, possible deep learning of the curriculum content and other emerging content and development and use of 21st century competencies.

One of the advantages of using the direct observation method is that it allows the researcher to gather information about the participants in their natural working environment. As a result, the data collected has high ecological validity, the methods, materials and setting of the study that must approximate the real-life situation that is under investigation (Brewer, 2000). The data collected during this direct observation included both objective and subjective information needed to address the research questions. In addition to direct observations, teachers’ and students’ consent were also obtained to carry out observation by camera, videos and audio recordings.

**Interviews.** Conducting interviews was one of the methods used to elicit participants’ perceptions, opinions, and experiences before, during and at the end of the intervention. According to Seidman (1998), “If a researcher’s goal . . . is to understand the meaning people involved in education make of their experience, then interviewing provides a necessary, if not always completely sufficient, avenue of inquiry” (p. 4). The interview is also a way of obtaining more authentic and truthful information from the participants than, for example, from a questionnaire, in which the information can be compromised if participants collaborate to provide prepared or coached responses.

For instance, for these interviews, neither the teachers nor their students were privy to the questions that needed to be asked. So there was no opportunity for the teachers to collaborate to provide desirable answers nor was there any opportunity for students to be coached by their teachers to provide desirable answers that may be biased or misleading about the actual
experiences encountered during their participation in the learning tasks’ activities. The information obtained was believed to be authentic and genuine based on the students’ understanding and perspectives.

Before interviewing the teachers and randomly selected student participants (six from each class, comprising five groups for the pre-, mid- and post interviews), I assured them that it was important for them to be honest about their experiences and the tasks’ activities, and that their critical feedback would be constructive for improving the tasks’ activities and by extension, the design and building of their video games. They were also assured that whatever was said during the interviews would be confidential. The interviews took place in private rooms to ensure that the teachers and the students were in an environment where they felt comfortable and safe to be vocal and honest about their experiences and perspectives on the tasks’ activities.

The pre-interview was used to elicit background information about the teachers and students prior to the start of the intervention, on ‘what exists’ or ‘what is’. The teacher participants’ pre-interview (see Appendix G) focused on the instructional strategies or ways they frequently used to teach their students social studies, their opinions on the learning characteristics of their students and the use of the design and building of digital video games to teach social studies curriculum content. The students’ pre-interview (see Appendix G) focused on their opinions and perspectives on how they learned or were taught in their social studies classes, how they would prefer to learn, their technology and video-gaming competencies and their opinions on using the design and building of digital video games as a way to learn in their social studies classes. The data from the pre-interviews was also used to inform the description of the teachers and students as participants in this research study.

The mid- and post interviews for both teacher participants and students (see Appendices H and I) were purposely developed during the implementation of the learning tasks, and were
informed by the research questions, the findings from the observation protocols, students’ and teachers’ blogged experiences during their participation in the learning tasks’ activities, teacher participants’ documents, teacher-researcher artifact and students’ game artifacts. More specifically, these interviews also sought to substantiate researcher observation and to provide further evidence that would help to address the questions that guided this research study.

The interview questions were mainly open-ended, providing opportunities to probe further into teachers’ and students’ experiences and to clarify questions that were probably misunderstood. Before conducting these interviews, the questions were first reviewed and piloted with other doctoral students to ensure clarity and alignment with my research questions. With teacher and student participant approval, I audio-recorded and presented these transcribed interviews to them for validation to ensure the accuracy of the information they provided.

**Qualitative data sources.** To confirm and explain the data being collected and analyzed from the observation protocols and interviews, various data sources were also used.

**Blogs.** Blogs, defined as “frequently updated online personal journal[s] or [diaries]” (Byrd, 2014, So What Is a Blog? section, para. 2) were used to replace the field journal or diary in this research study. Although the teacher participants stipulated that the use of blogs in their classes was new to them and a low number of students (28) indicated that they used it, both teachers and students preferred to use the blog rather than the field journal because it provided easier and quicker access to their written experiences. More specifically, the students utilized Kidblogs, created by their teachers, for them to engage and reflect on their learning, while also providing evidence of the product of learning (Churchill, 2009; Coric, Balaban & Bubas, 2011). One of the teachers explained that the kidblog was “very good at communicating what [students] learned along the way. With regards to their knowledge [and] what it means to be an effective
collaborator, there is a rich amount of information there for us to see” (Post interview, June 2014).

The teachers maintained control over these blogs and user accounts by monitoring all activity within their classroom blogging communities (Kidblog, 2015). They also blogged and reflected on their experiences in the teachers’ blog, although not as much as the students did in their kidblogs. During their implementation of the learning tasks, the teachers posted assignments to the students and provided feedback on these assignments, utilizing the kidblogs and Edmodo, “a web-based platform . . . to connect and collaborate, share content, and access homework, grades and school notices” (Educational Technology and Mobile Learning, 2014, What is Edmodo? section, para. 1). The teachers referred to Edmodo as their Learning Management System (LMS) and one of the students described it as “kinda like Facebook for school” (Pre-interview, October 2013).

*Teachers’ documents and teacher-researcher artifact.* The teachers collaboratively created a game design unit plan (see Appendix J), which comprised a number of lesson plans to inform their design of instruction and learning tasks’ activities as they implemented the learning tasks. Teachers also collaboratively designed assessments rubrics (see Chapter 4 and Appendix L) to assess individual students’ and groups’ performance in the game concept development task, storyboarding task and throughout all the learning tasks. Samples of the feedback and results from some of these assessments can be seen in Appendices M, S and T.

After presenting the teachers with an initial framework for the design and implementation of the intervention in the prototyping phase of the design-based research process, this framework was modified by the teacher participants and then remodeled by both teacher participants and researcher, resulting in a collaborative framework that we agreed to implement (see Appendix N).
This collaborative framework was further modified during the actual implementation of the tasks, as depicted in Figure 9.

*Students’ game artifacts.* Artifacts or samples of the student participants’ work including game concepts, storyboards and prototype 1 of final games (see examples in Chapter 5 and Appendix O) were collected with their permission and the permission of their teachers and parents. These artifacts were used as data sources and supporting evidence of common themes emanating from the interviews and observations during the analysis of the data in order to address the research questions.

**Trustworthiness of Data Collected**

As a design-based researcher who was intimately involved in the conceptualization, design, development, implementation and exploration of the intervention as a potential innovative pedagogy to address the problem that initiated this present research study, I need to ensure that I can make assertions or claims that are credible and trustworthy (Barab & Squire, 2004). Therefore, this research study was guided by Lincoln and Guba’s (1985) criteria for establishing the trustworthiness of naturalistic data: credibility, dependability and confirmability.

Credibility requires the identification of all important factors in the research question(s) and accurately and completely describes the ways in which these factors are reflected in the data gathered. Dependability addresses the concept of replicability, which is defined as “stability after discounting . . . conscious and unpredictable (but rational and logical) changes” (Guba & Lincoln, 1981, p. 247) in findings during repetitions of the study (White & Marsh, 2006).

To ensure that the data for this research study is credible and dependable, I employed a multi-method approach—surveys, direct observation and interviews supported by data sources, such as blogs, teachers’ documents, teacher-researcher artifact and student game artifacts. This
approach allowed for actual observed, written and quoted descriptions and visuals of teacher participants’ design of instructional and learning tasks’ activities and any impact that students’/groups’ design and building of their video games may have had on their intellectual engagement, deep learning of how the citizens in their various models participated in the government decision-making process and development and use of 21st century competencies. This way, there would be no doubt that the experiences being described and quoted were directly from the teacher and student participants and not written from my perspective or my interpretation of what I thought was said, seen and done.

To further ensure the credibility and accurate representation of the data in this research study, two formal subjectivity checkpoints, including my supervisor and participants’ review, were employed within the study. Throughout and at the end of the data collection and analysis processes, the findings were shared with the teacher and student participants to verify the data collected and their interpretations as well as my supervisor from whom I also sought her expert review and opinions.

Confirmability helps to “ensure as far as possible that the work’s findings are the result of the experiences and ideas of the informants, rather than the characteristics and preferences of the researcher” (Shenton, 2004, p. 72). As such, triangulation of data from multiple sources [of data], was employed to document the experiences of the teachers and students, diminishing the possibility that one perspective alone or even that of the researcher would shape the course or determine the outcomes of work or study in addressing the research questions (Stringer, 2008).

It is also an area of trustworthiness that the researcher addresses by keeping a research diary or journal, which includes his/her field notes and data. Before and during the research study, I kept a research journal with supporting audio, video and visuals, which can serve as a reference for others who are not involved in the research to find evidence of the types of activities
and decisions that the research design team made in carrying out this research. The target reading audience in [any type of research] needs to be reassured that the research process utilized is convincing, logical, and consistent throughout the research and ethically sound (Crowson, 1987).

This research journal comprised a list of the teacher and student participants; emails to and from the participants and my research supervisor; review notes and feedback from my supervisor and other members of my supervisory committee; my ideas about the research process; a detailed research plan; a list of activities to be carried out to implement and complete this research; the data collection methods utilized; detailed effects of the intervention observed; design narratives, more specifically, teacher and students’ blogs with first person accounts of their experiences to provide the target reading audience with some idea of what they were experiencing while participating in the design and building of the video games; and my reflective feelings and emotions about the use of that particular intervention, its effects on teaching practice, student engagement, deep learning and development of 21st century competencies, learning and instructional theories and other experiences collected and observed from the participants. Other researchers who are able to follow a similar research process may be able to discover and document comparable (but not conflicting) findings.

**Procedures for Analysis of the Data**

The analysis of the data was guided by the principle of design-based research on data analysis, that is, the data collected was “analyzed immediately, continuously, and retrospectively” (Wang & Hannafin, 2005, p. 17) during and at the end of the game concept development, storyboarding and programming tasks (on an ongoing basis). During the implementation of these tasks, this analysis informed (i) some of the changes/modifications to teacher participants’ design of instructional activities and iterations to the learning tasks’ activities, where necessary, in order
to meet the learning goals; and (ii) assisted in deciding, according to Mills (2007), “if we [were] learning what we had hoped to learn” (p. 121), that is, collecting data that was successfully indicating that one of the main goals of the intervention was being achieved, that is, to answer the following questions that guided the research:

1. In what ways do teachers’ design of instruction and learning tasks need to shift when designing and building digital video games to intellectually engage students in deep learning of curriculum content and to develop and use of 21st century competencies in school?

2. In what ways does the design and building of digital video games in school impact students’ intellectual engagement, deep learning of curriculum content and the development and use of 21st century competencies?

To carry out the analysis of the collected data, a framework analysis (Ritchie & Spencer, 1994) was adapted. This form of analysis comprises five key stages:

1. Familiarisation— “immersion in the data: listening to tapes, reading transcripts, studying observational notes” (p. 312);

2. Identifying a thematic framework—initial coding framework “drawing upon a priori issues, emergent issues raised by the respondents themselves and analytical themes arising from the recurrence or patterning of particular views or experiences” (p. 313);

3. Indexing— “process whereby the thematic framework or index is systematically applied to the data in their textual form” (p. 316) to identify specific pieces of data which correspond to the various themes (Lacey & Luff, 2001);

4. Charting—using headings from the thematic framework, “the data are lifted from their original context and rearranged according to the appropriate thematic reference” (p.
328) to create charts of the data so that they can be easily read across the whole dataset (Lacey & Luff, 2001);

5. Mapping and Interpretation—“reviews charts and research notes, compares and contrasts perceptions, accounts or experiences, searches for patterns and connections, and seeks explanations for these internally within the data” (p. 321), aided by visual displays and plots (Lacey & Luff, 2001).

One of the benefits of Framework Analysis is its ability to provide systematic and visible stages to the analysis process, so the stages by which the results have been obtained from the data are clearly evident (Lacey & Luff, 2001).

Within this framework analysis, I employed the following procedures using steps 1, 2, 3 and 5:

(a) I read through and reviewed, for example, my observational notes, the transcribed interviews, teacher-student and group discussions, instructional conversations and teaching moments, teachers and students’ blogs, teachers’ documents and students’ game artifacts, looking for content that was pertinent to addressing the questions that guided this research.

(b) I used a priori (explicit) coding—categories or data sets established before the analysis based upon the research questions and emergent (implicit) coding—categories or data sets established after preliminary examination of the data to categorize the data into themes/topics (Stemler, 2001). For instance, examples of the a priori categories used to organize the data included game concept development task, storyboarding task, programming task, design of instructional procedures/activities, shifts in design of instructional procedures/activities, iterations of learning tasks’ activities, students’
intellectual engagement, deep learning and 21st century competencies. Using these categories, provides protection against data overload (Allan, 2003).

Within these categories, for example, a search was made through my observational notes, the transcribed interviews, teacher-student and group discussions, instructional conversations and teaching moments, teachers and students’ blogs, teachers’ documents and students’ game artifacts for content that correspond to differing themes/topics and coded for connections within and between the a priori categories by labelling or highlighting them using a colour-coding system.

(c) In this research, I chose to employ the selective or highlighting approach, which entailed that I read the content from each data source several times and asked, ‘What statement(s) or phrase(s) seem particularly essential or revealing about the categorized themes/topics and emerging experiences being described?’, with the ensuing statements then being highlighted (van Manen, 1990). I made the decision to use the selective or highlighting approach after considering both the form of the data being generated and the way it was acquired. I then closely reviewed the content and highlighted each significant statement according to the theme/topic it reflected.

(d) In reviewing the content, I also identified and labeled or highlighted emerging “concepts, actions or meanings that evolved from the data” (Stuckey, 2014, Categorizing the Data into Codes section, para. 2), which provided supporting content to that revealed in the a priori categories.

(e) After completing my colour coding, I then re-categorized and organized the significant statements according to the themes/topics they reflected. For example, statements that described the ways teachers needed to modify their design of instructional procedures/activities were placed under that theme, for example, ‘Instructional shifts in
learning tasks’. Statements that described deep learning of the government decision-making process according to task were placed under the theme/topic, for example, ‘Deep learning of government decision-making process in game concept development task’. Emerging content such as statements that described deep learning of the game design principles were placed under the theme, for example, ‘Evidence of deep learning of game design principles’ and statements that described a relationship between deep learning and intellectual engagement were placed under the theme/topic, ‘Connection between deep learning and intellectual engagement’.

(f) In coding the data for the categorized themes/topics and emerging experiences being described, I also utilized a constant comparative method (Taylor & Bogdan, 1998). Every time a significant statement was selected and colour-coded in one data source, it was compared with other significant statements with similar colour codes in the other data sources to ensure that the coding was consistent. Finally, I collected and tabulated all the significant statements and placed them under themes/topics according to the categorized themes/topics and emerging experiences being described, as seen in Chapter Five.

To also address each research question, I analyzed the teachers’ and students’ emerging experiences by adapting Moustakas’ (1994) development of textual description—the ‘what’ not the ‘why’ of the teachers’ and students’ experiences to identify and describe rich accounts of (i) the ways in which teachers needed to shift their design of instruction and learning tasks in their attempt to intellectually engage their students to deeply learn how the citizens in their various models participated in the government decision-making process and develop and use 21st century competencies and (ii) the ways in which students’ design and building of their video games impacted their intellectual engagement, deep learning of how the citizens in their various models
participated in the government decision-making process and their development and use of 21st century competencies.

First, I identified the original data, which comprised my observations informed by the observation protocols, ‘naïve’ descriptions obtained through the interviews, teachers’ blog and Kidblogs, teachers’ documents and visuals from the students’ game artifacts. Then, I described the structure of the experience based on reflection and interpretation of the research participants’ stories and visuals. The aim of this analytical approach is to determine what the experience means for the people who have had the experience. From there, general meanings are derived and used to illustrate the answers to the research questions as accurately as possible and to help address possible researcher bias.

**Ethical Considerations**

I successfully completed the Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans (TCPS 2: CORE) Tutorial and subsequently applied to the Conjoint Faculties Research Ethics Board (CFREB) in January 2013 for ethical approval to carry out this present research study. By the end of February 2013, I received a response from the Board’s Chair requesting, on behalf of the Board, to address some concerns they had with the application before approval could be given. For instance, there were concerns about the involvement of classroom teachers and/or school administrators in the introduction of the study to the students, the collection of signed parental consent forms, teachers being informed as to the identity of any non-participating children, video and/or photographs containing no personally-identifying features of the students participating in the study, some of the content in the parental and teachers’ consent forms and the creation of a child assent form.
With the assistance of my supervisor, we modified the application by addressing these and other specified concerns and re-submitted by March 2013. Approval was given within a week of our submission of the modified version to begin data collection in the chosen local context, a charter school in Calgary. My supervisor and I subsequently attended a meeting with the Board to further discuss the nature of the research (DBR) and to address any other issues about the research that needed to be clarified. One specific area of concern, especially by parent representatives was whether students’ academic performance would be adversely affected if parents did not consent to their child/children participating in the research. We made it clear that at no time, students who were not given parental permission to participate would be maligned or treated differently to their peers. They would still be invited to participate with their peers, but no data would be collected from them, neither would their work samples be used as data sources.

By August 2013, I reconnected with the two grade 6 teachers and the professional development leader from the charter school who had shown interest and volunteered to participate in the research study. In our meeting, I re-introduced and provided them with a detailed overview of the research process and discussed, with them, the details on the nature of their participation in the research study. I also presented them with the research problem, a brief review of the literature on the problem and the proposed research-informed design solution to address the problem, an intervention/the design and building of digital video games. We also discussed the potential benefits of the research study to the school, parents, themselves and their students.

Upon receiving their verbal agreement to participate in the research, as the researcher, I committed to carrying out the research intervention with the two teachers, their students (100) and the professional development leader. I then distributed the Educator consent form to the teachers and professional development leader and arranged to distribute the Parent/Child consent
(see Appendices P and Q) to the students’ parents. The participants were given two weeks to consider the consent information, and the opportunity to ask questions or seek clarification about the study before officially consenting to participate by signing the consent forms I provided. They were also informed of the choice to withdraw from the study without penalty, after consenting, in the event that circumstances were making it difficult for them to continue participating. Within two weeks, I collected the completed consent forms from both the teachers and students’ parents. In addition to the teachers’ consent, I received consent from all the students’ parents for their child/children to participate in the research. Upon obtaining their parents’ consent, I scheduled one-hour meetings with two grade 6 classes, at a time, to complete the child assent form (see Appendix R) with the students. Every child assented to participate in the research and gave permission to collect data from them and to use samples of their work as evidence.

During the research process, there were no risks to the participants as the research process was designed to take place in the safety of the school environment, ensuring that the participants were not harmed or exploited in any way. As an assurance of the confidentiality of their identity and documented experiences, I safeguarded all copies of field materials including teacher and student blogs, transcribed interviews, videos, audios and teacher and student artifacts that contained identifying information by keeping them in a secure location as well as ensuring that all digital data with identifying information was encrypted and password protected. Pseudonyms were used instead of participants’ names to protect their anonymity.

To promote the equitable distribution of the potential benefits of this research, I sought and received permission from the participants to:

- disseminate the results of the research in presentations and peer-reviewed publications;
provide copies of publications or other reports resulting from the research to the participants’ institution, professional association or other recognized body to further the dissemination of new knowledge generated from this research study;

- provide information about the results of the research to participating individuals, groups, and communities in a language and format that is respectful of their needs (TCPS2: CORE; Fairness and Equity).

**Limitations of the Research Study**

The main goal of this research study was to carry out an intervention/the design and building of digital video games in the four grade 6 classes at a charter school to explore its potential or effectiveness as an innovative pedagogy that can intellectually engage students in the deep learning of curriculum content and development and use of 21st century competencies. However, with this intent came with some limitations.

In carrying out this research, my multiple roles as researcher, designer, facilitator and observer posed a limitation to the research study. Barab and Squire (2004) noted that this role could threaten the validity of the research because “design-based researchers are not simply observing interactions but are actually ‘causing’ the very same interactions they are making claims about” (p. 9). They claimed that if the researcher is “intimately involved in the conceptualization, design, development, implementation, and researching of a pedagogical approach”, as is the case in this research study, then “ensuring that researchers can make credible and trustworthy assertions is a challenge” (p. 10). Therefore, in order to preserve the validity and credibility of the research findings in this research study, I, as advised by Barab and Squire (2004), drew on methodological practices consistent with other qualitative methods as outlined
by Lincoln and Guba (1985) to convince others of the trustworthiness and credibility of claims being made in this research study.

In terms of the significant results of this design-based study, Amiel and Reeves (2008) noted that “it would be idealistic to expect significant and transferable results from a onetime study of a technological intervention” (p. 35). Therefore, the results obtained from this research study served as a starting point for “generating more transferable and useful results” (p. 35) in game-based learning, more specifically, game design-based learning in the formal classroom setting.

Time constraint was a limitation in this research study. According to Dave, “Time was the biggest challenge because this is a project that has taken much more time than we expected” (Post interview, June 2014). In addition, the flexible school’s activities and difficulties encountered in setting up the hardware for students’ use in the library, difficult collaboration and challenges with the tasks’ activities in some groups, slow Internet connection and challenges of the distance between the programmer and the rest of the group during the programming task impinged on the amount of time that most groups had to complete at least the first prototype of their games.

In his comments on the challenges of the distance between the programmer and the rest of the group during the programming task, Matt explained:

You know looking back, just the logistics of it, having laptops would have been much, much better. The fact that we had iPads, meaning that we had to use the library space, which sometimes wasn’t available, it was a frustration for me and I know it was a frustration for them, too. Had we had a perfect environment where they always had access to the computer whenever they needed it, and they had access to the group members, I think we could have got probably double the output.

94
I think we just had quite a few things working against us and you know we made
the best of an okay situation, but I don’t just feel like we set them up environmentally for
optimum success. Issues were exasperated by the fact that they had some challenges as
far as communicating with the programmer being up in the library and the other four
group members in the classroom, it didn’t create a cohesive group (Post interview, June
2014).

Practitioner-researcher communication was another constraint that was revealed during
the implementation of this intervention. On countless occasions, I had to reach out to the teacher
participants to continue the process when there were long delays in communicating a stable
schedule for initiating the intervention and in implementing the prototyping phase of the process,
especially. This posed some frustration and also extended the original timeline for the
prototyping phase of the DBR the process, as well as the collection of data.

As part of its research methodology, more specifically the research design, and in an
effort to contribute to the trustworthiness of the collected data, it also became necessary to
provide a detailed description of the actual implementation of the intervention/the design and
building of digital video games as it occurred in the prototyping phase of the DBR process, and
detailing the context within which the data was collected, to address the research questions. This
implementation is presented in Chapter 4.
Chapter 4: Implementation of the Intervention

Introduction

In this research study, the implementation of the intervention took place in one macro-cycle of the design-based research process (see Figure 7). This macro-cycle included one micro-cycle of the preliminary research or analysis and exploration phase, during which the intervention was adopted into the educational context; one micro-cycle and three meso-cycles of the prototyping phase, during which the intervention was explored; and one micro-cycle of the assessment or evaluation and reflection phase, during which the intervention was assessed as a potential and effective innovative way or pedagogy that can also possibly address the problem that initiated the study. A discussion of the actual implementation of the intervention using the three core phases of the DBR process, follows.

![Diagram of Design and Building Digital Video Games Adopted, Explored and Assessed in DBR Process]

*Figure 7. Implementation of the design and building of digital video games in macro-cycle of the design-based research process adapted from McKenney and Reeves’ (2012) micro-, meso- and macro-cycles in educational design research*
Preliminary Research Phase—Analysis and Exploration

The preliminary research phase or analysis and exploration phase is the initial phase of the design-based research process, which “constitutes one (empirical) micro-cycle [and] includes problem identification and diagnosis” (McKenney & Reeves, 2012, p. 79). It is at this phase that Amiel and Reeves (2008) suggest that design-based research should begin with “the negotiation of research goals between practitioners and researchers . . . in establishing research questions and identifying problems that merit investigation” (p. 35).

In this research study, however, establishing the research questions and identifying and discussing the problem supported by a review of the literature to understand and contextualize the problem (see Chapters 1 and 2), took place before I, as the researcher, reached out to the practitioners (teacher participants). I actually began collaborating with the teacher participants by presenting them with the goal of the research, a statement of the problem, a proposed research-informed design solution for the problem—an intervention/the design and building of digital video games and the rationale for choosing it as a solution. We also reviewed and discussed the literature on the game design-based learning context, within which the design and building of digital video games is located and the theoretical framework to support the design and implementation of the intervention in the classroom context.

As recommended by Reinking (2014), this helped to vet the teacher participants on the background of the research and to ensure they would be collaborative and open to the research process as their shared commitment to solving the identified problem around practice was of critical importance to the research. Subsequently, the research questions that guided the study, the observational protocols to guide the researcher’s initial direct observation of the prototyping phase of the process and some literature on the design-based research methodology were also
provided to the teacher participants in order to further familiarize them with the entire research process.

In our discussion of the identified problem, the teachers agreed that there is a challenge for K-12 educators in some Canadian schools to find new ways or innovative pedagogies to help their students learn and understand curriculum content at a deeper level. However, the teacher participants believed that the problem was more prevalent in other K-12 schools compared to their own school, which they indicated, explicitly emphasizes and values innovation. One of the teacher participants, Matt, stated that one of his main concerns within the context of the problem was more specifically, the situation that “there are kids that are struggling with how do I work in a system that sort of already has a design” (Pre-interview, October 2013). He further commented that he understands that teachers can’t customize everything for every child, but . . . too many teaching strategies are based on what’s easiest for the teacher . . ., what’s most efficient. With all those factors that I think other teachers and other schools are dealing with, . . . here at this school, we have no excuse to resort to teaching practices that are traditional and teacher-centred (Pre-interview, October 2013).

Dave, the other teacher participant, was mainly concerned about the gap between how students learn best and the ways that they were being taught and engaged in their learning. Accordingly, he stated,

sometimes, there can be a gap between the way students learn best and the practices that we’re doing. . . when I taught high school I was very concerned about the exams because that was my number one priority. . . get the tests done . . . I was an English teacher and teaching to the test and in that scenario you were teaching exactly the curriculum . . .
which wasn’t necessarily done in a way that was as engaging to some of the students (Pre-
interview, October 2013).

In considering the design solution or intervention, Matt also expressed some concerns
about the benefits of its implementation to his students’ learning:

What is it we are trying to achieve here? While [students] can become distracted with the
details of the video game, where are we going with this? Is this going to help to deepen
their understanding? We don’t want a task just for the task’s sake (Pre-interview, October
2013).

His concerns were synonymous to one of the concerns presented in the stages of concern
dimension of the Concerns-Based Adoption Model (C-BAM) (Hall, Wallace & Dossett, 1973).
They were mainly consequential—How is it going to impact the students? As part of the
decision-making process for adoption, it was important to discuss the teachers’ concerns.
“Understanding the concerns of those who will use interventions created through educational
design research is essential to shape both design and implementation” (McKenney & Reeves,
2012, p. 174). Therefore, to help address these concerns, we reviewed and discussed the
proposed framework for the design and implementation of the intervention in the prototyping
phase of the DBR process, and how it could be implemented to intellectually engage their
students in deep learning of chosen social studies content, while equipping them with 21st century
competencies.

The design of the proposed framework was based on an assessment of the problem
identified and informed by relevant game design-based literature, learning theories, specifically,
Herrington and Oliver’s (2000) nine characteristics of the evolving theory of situated learning
environments, which formed its theoretical framework and game design principles adapted from
Mellini, Talamo and Giorgi’s, (2010) embedded educational characteristics of gaming, learning and technical aspects (discussed in Chapters 1 and 2; Table 3 in Appendix B).

The proposed framework comprised a five-phased team-based, iterative process (as seen in Appendix N) adapted from, and informed by Hung’s (2006) 3R3C model of problem-based learning environments. Hung’s (2006) 3C3R model represents a conceptual framework for designing problems that includes “content, context, and connection—core components that are used to support content and conceptual learning and researching, reasoning and reflecting—processing components that are concerned with students’ cognitive processes and problem-solving skills” (p. 56).

After reviewing and discussing the proposed framework, Matt and Dave indicated that they were willing to adopt it, on a trial basis, as a more innovative way to help their students learn and communicate their understanding of social studies content, while at the same time become more engaged in their learning and develop 21st century competencies. According to Matt, there is a need to give students more options as far as how they get to learn and show what they’ve learned. . . It’s about where you are in your thinking, where you are in your conclusions that you’re drawing and how you share them now. There’s other ways that we can sort of verify that besides formal writing exercises (Pre-interview, October 2013).

Subsequent to our review and discussion of the proposed framework, the teacher participants modified it (as seen in Appendix N) based on their students’ learning needs and their teaching goals. The main difference between their version and the proposed version appeared in the statement of the learning goals, the specified curriculum content that the students needed to learn and understand during the design and building of their video games, and the teachers’ expectations of student performance informed by formative and summative assessments.
The teacher participants’ input was critical to the design of the framework because they were more knowledgeable about their students’ learning needs, the context (including the nature of their students) within which the implementation of the intervention would take place and the learning and teaching goals they wanted to achieved in exploring this intervention. Informed by the teacher participants’ design, I then modified the proposed framework, which resulted in a collaborative design that the teachers agreed to implement (see Table 10, Appendix N). However, as we implemented our collaborative framework, it needed to be further modified in order to meet the learning and intervention goals of the research process (see Figure 9).

Having achieved a shared understanding of the intervention and its possible benefits to their students’ learning, the teacher participants also discussed the potential constraints within which the design and building of the video games needed to operate in the classroom context. Foremost among these constraints was the hardware—grade 6 students mainly used iPads and not laptops, which would present some difficulty in downloading the chosen game software, Scratch, since it mainly run on laptops and desktop computers. Another possible constraint was the difficulty in planning a fixed schedule for the implementation of the learning tasks because of the school’s flexible activity schedules.

With an understanding of the problem, the design and implementation of the intervention and the main constraints within which this intervention would need to operate, we then planned and implemented the intervention in the local context. It should be noted that during the implementation of the intervention in the prototyping phase of the DBR process, the teacher participants were the instructional leaders, but also functioned in a collaborative decision-making partnership with the researcher and their students/groups (Brown, 1992; Reinking, 2014).
Prototyping Phase—Design and Construction

In design-based research, the prototyping phase or design and construction phase is the iterative design phase consisting of iterations, each being a micro-cycle of research, mostly through exploration, with formative evaluation as the most important research activity aimed at improving and refining each stage of an intervention (McKenney & Reeves, 2012; Plomp, 2007). In this research study, the intervention is explored in the prototyping phase of the DBR process. This exploration took place mostly as a planned process, which included the intended goals, methods and strategies and implemented in one planning task and three learning tasks—game concept development, storyboarding and programming (see Figure 9) from August 2013 to June 2014. More specifically, the lived timeline for the exploration of the intervention began on sporadic days extending from August to December 2013 and developed into a more solid schedule from March to June 2014, as seen in the following timeline (Figure 8).

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Planning</td>
<td>18</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Game Concept Development</td>
<td>7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Storyboarding</td>
<td>9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Programming</td>
<td>21</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 8. Lived timeline for the actual exploration of the intervention in the prototyping phase of the DBR process

This timeline is a modification of the original timeline that was proposed from September 2013 to March 2014, in students’/groups’ design and building of their video games was scheduled for two and three days per week, simultaneously. However, sessions had to be re-scheduled to 2 days instead of 3 days weekly because of the unplanned activities that took place in the school. There was also a long pause between the end of the Scratch training sessions
(December 2013) and the implementation of the first learning task, game concept development (March 2014). This was due to outdoor camps held for grade 6s from the beginning of January to the end of February 2014.

Figure 9. Framework for the actual design, implementation and exploration of the intervention in the prototyping phase of the DBR process
Planning Task

The planning task represents one micro-cycle of design and construction of the task’s activities and was implemented sporadically, from August to December 2013. To initiate this task, the teacher participants, in collaboration with the researcher, identified and defined the curriculum content-specific learning goals for the design and building of the digital video games. The learning goals included: (1) to recognize how individuals and governments interact and bring about change within their local and national communities; (2) to demonstrate an understanding of the fundamental principles of democracy; and (3) to analyze the structure and functions of Alberta’s provincial government (Alberta Education, 2007).

The teacher participants also identified the curriculum content (see Appendix K for detailed content) that should inform the domain knowledge of students’/groups’ video games as they tried to solve the given problem, ‘How did/do the citizens participate in the decision-making process?’ to achieve the learning goals. The specific areas of the curriculum content identified included: decision-making method (consensus, representative democracy, majority and plurality voting) using a historical model of decision making (Ancient Athens, Iroquois Confederacy, Municipal and Provincial [current era or modern day]) (Alberta Education, 2007).

Upon establishing the learning goals and curriculum content for the design and building of the video games, the teacher participants, in collaboration with the researcher, created teams/groups (story writer, artist, musician/sound engineer, programmer, leader) within which the student participants could utilize a variety of perspectives to collaboratively construct and design their knowledge/ideas as they designed and built their video games. In so doing, the teachers and researcher collaboratively began to create the conditions and a learning environment that was all-embracing to reflect the ways that the knowledge constructed was not separated from
the noise, confusion and group interactions prevalent in real work and exploratory environments (Brown et al., 1989; Reeves & Reeves, 1997).

The story writer in each team/group was responsible for drafting and managing the stories and dialogues that would inform their game concepts. The artist was responsible for designing and managing all the artistic aspects of the game including the graphics, textures, backgrounds, models, characters and animations. The musician/sound engineer was responsible for creating sounds and background music for the scenes in the game. The programmer was responsible for building (coding, scripting, testing, refining) the game prototypes. The leader was responsible for managing the group’s activities and ensuring that group members remained on task. The creation of these groups were mostly informed by the results of two surveys, Video Game Experience survey (see Appendix D) and My Learner Profile survey (see Appendix E).

Twenty student groups (five students in each group) were created within which students could collaboratively design and build their video games—five groups in each class—two homogenous groups of males and females and three mixed groups. The rationale for this grouping method was to inform further research into the impact of gender on the design and building of video games in the school context. Members for each of the 20 groups were placed, based on the assigned roles informed by the results of the My Learner Profile survey and their experience in building video games informed by the results of the Video Game Experience survey. For instance, all students who indicated that they had coding or programming skills (simple to sophisticated) were the first to be placed in each group. Then other members were placed based on their strongest skills as story writers, artists, musicians or leaders. Some of the students in each group were also multi-skilled, and this worked favorably for the groups, as discussed in the findings in Chapter 5.
Based on their knowledge of their students’ abilities, teacher participants also had an input in the final decisions for each student’s assigned role. After students were informed of their roles in the assigned groups, they were given the opportunity to accept or change the given role, especially those who indicated that they were multi-skilled. Six students who were assigned as programmers accepted their roles, while the remaining 14 accepted other roles in which they felt they could more effectively and confidently contribute towards the design and building of their video games.

In order to acquire some pre-requisite knowledge and skills in creating digital video games (mini-games) and in preparation for the actual design and building of the video games during the learning tasks’ activities, the student and teacher participants participated in formal training and practice sessions in the use of the chosen game software, Scratch, over a four-week period (ten classroom sessions and flexible amount of time beyond the classroom). This was critical to the process since both teachers and 79% of student participants indicated that they had no experience in building video games. All the participants also needed to familiarize themselves with the game software they intended to use in designing and building their video games as well as the knowledge and skills of the types of interactions that the games required.

Students were also allowed to play various types of video games including those built in Scratch. Whilst playing the Scratch games, they were also encouraged to ‘see inside’ the games by accessing the scripts, costumes and sounds to become familiar with how other video game designers coded and scripted their games. The training period helped to stimulate the students’ enthusiasm for designing and building video games, which needed to be carried over to the actual design and building of their games during the learning tasks. For teacher participants, especially, the training and practice with Scratch helped to support their intended instructional activities.
As discussed in the physical context of the research, to inform this training and practice, the researcher provided training videos on Scratch (see Appendix C), to the teacher participants, who uploaded them on Edmodo for easy access to students within and beyond classroom sessions. The first week of training took place in the library in 20-minute sessions due to the limited number of iMacs available to the students, since as explained earlier in the context, Scratch could not be accommodated on the students’ iPads, at that point in time, and laptops were not readily available. Students blogged on their experiences in learning Scratch and while a few seemed frustrated with the limited resources to learn and practice using Scratch, most (including those with previous experience in using Scratch) seemed to enjoy and master their knowledge and skills in Scratch.

To address this frustration and to provide students with more time and opportunities to learn Scratch, the teacher participants, including the professional development leader, researched and discovered an app to download Scratch on the iPad. Students were asked to purchase the app, at a very low price and by the middle of the second week of training, all the students were able to continue their Scratch training on their iPads, although a few preferred to continue on the iMacs.

During the training and practice sessions, the teacher participants encouraged all their students to master the elements of the game software, particularly the programmers in each group, who were mainly responsible for building the video games. By the end of week 4, based on researcher and teacher participant observations and the initial game artifacts produced, we observed a range of success in terms of student proficiency. About 87% of the students seemed able to construct simple to elaborate games (chosen programmers included), while others were
still struggling with the basics. It was still early on in the process, therefore, there was time for everyone to practice and improve on their Scratch before the actual programming of the games.

In preparation for the implementation of the learning tasks, the teacher participants introduced the curriculum content, with instructions for the learning tasks’ activities, to each class.

**Learning Tasks**

The learning tasks—game concept development, storyboarding and programming represent meso-cycles of exploration and refinement of the tasks’ activities informed by a formative evaluation/assessment, reflection, feedback and refinement strategy and were implemented from March to June 2014. Teacher participants used this strategy to inform their designed instruction in an effort to promote the effectiveness of the learning tasks to meet the learning and intervention goals, particularly, the game concept development and storyboarding and to assess students’/groups’ progress. In the programming task, a modified form of this strategy tended to be used mostly by the students/groups as teacher participants took a more hands-off approach during this task.

The teacher participants’ design of instruction for each of these learning tasks also seemed to be informed by a variety of instructional activities, as listed in Table 11, and described in the Classroom Teacher Observation Protocol for Teacher Performance and Behaviours (see Appendix F). These instructional activities represent the instructional framework for the implementation of these tasks. Design principles (as seen in Table 12) also informed the design construction and implementation of the specific learning tasks’ activities/ideas used to generate and explore potential solutions to the given problem.
Table 11

**Instructional Activities Based on Classroom Teacher Observation Protocol for Teacher Performance and Behaviours**

<table>
<thead>
<tr>
<th>Instructional Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seeking various modes of problem solving</td>
</tr>
<tr>
<td>Reflective learning</td>
</tr>
<tr>
<td>Conceptual thinking</td>
</tr>
<tr>
<td>Divergent thinking</td>
</tr>
<tr>
<td>Pedagogical content knowledge</td>
</tr>
<tr>
<td>Intellectual rigor, constructive criticism, and the challenging of ideas</td>
</tr>
<tr>
<td>Instructional strategies and activities to probe students’ existing knowledge and preconceptions</td>
</tr>
<tr>
<td>Connections between content and real life/world situations</td>
</tr>
<tr>
<td>Coaching and scaffolding</td>
</tr>
<tr>
<td>Teacher-student discourse and collaboration</td>
</tr>
<tr>
<td>Teacher-teacher discourse and collaboration</td>
</tr>
<tr>
<td>Formative assessment</td>
</tr>
<tr>
<td>Feedback</td>
</tr>
</tbody>
</table>

Table 12

**Design Principles to Guide Learning Tasks’ Activities/Ideas**

<table>
<thead>
<tr>
<th>Design Principles</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Anchored instructional activities</strong></td>
</tr>
<tr>
<td>Students allowed to define and investigate problem or given information; students allowed to experience the given problem from a number of different perspectives; students working on the problem over a sustained or ‘reasonably long period of time’, that is weeks rather than days; activities should be logically related to the problem to be investigated (Bransford, Vye, Kinzer &amp; Risko, 1990; Herrington &amp; Reeves, 2011)</td>
</tr>
<tr>
<td><strong>Climate for reflection</strong></td>
</tr>
<tr>
<td>Students are provided opportunities to clarify the understanding of their ideas through reflection; time is provided to reflect and work on solving the problem (Boud &amp; Knights, 1996; Herrington &amp; Reeves, 2011)</td>
</tr>
<tr>
<td><strong>Design and development of web-based materials using new technologies</strong></td>
</tr>
<tr>
<td>Chosen meaningful contexts for the learning of the curriculum content; support and a variety of resources provided; use of authentic assessment activities (Herrington &amp; Reeves, 2011; Oliver, 2000)</td>
</tr>
</tbody>
</table>
**Design Principles**

| Culturally inclusive instructional design | Epistemology that is consistent with, and supportive of constructivist learning adopted; designed authentic learning activities; flexible tasks and tools for knowledge sharing created; different forms of support provided within and outside the classroom community; flexible and responsive student roles and responsibilities established; communication tools and social interaction for learners to co-construct knowledge provided; tasks for self direction, ownership and collaboration created; flexible tutoring and mentoring roles that are responsive to learner needs provided; access to varied resources to ensure multiple perspectives created and provided; flexibility in outcomes and modes of assessment provided (Herrington & Reeves, 2011; McLoughlin & Oliver, 2000) |

Guided by their instructional activities and the design principles informing the design and construction of the learning tasks’ activities/ideas, the teacher participants implemented the learning tasks’ activities, particularly the game concept development and storyboarding tasks, through “successive approximations of the desired solution” (McKenney & Reeves, 2012, p. 79). These successive approximations or iterations were informed by the results of the formative evaluation/assessments, reflections and refinements, as well as some of the findings from the continuous analysis of data collected through researcher direct observation using the observation protocols, teachers’ blog, kidblogs, mid-interviews and teachers’ documents.

**Game concept development task.** The main goal of the game concept development task, according to the teacher participants, was for students to develop a game concept that would achieve the learning goals as they demonstrate their deep understanding of their chosen topics, while providing the target game player with a “learn as you go experience” (Matt, Mid-interview, April 2014). The game concept was based on the problem, “How did/do the citizens participate in the decision-making process?” and embedded in a narrative/storyline that a player needed to
follow in order to solve the problem. To develop that game concept, the teacher participants presented all groups with the following plan, as seen in Figure 10, details of the task’s activities listed in Table 5.

![Figure 10: Initial game concept development plan](image)

To initiate the game concept development task, the teacher participants collaboratively held an introductory 15-minute teaching moment with two classes per session (50 students) to describe the task’s activities that had to be completed to develop their game concepts. Subsequently, the teachers held those 15-minute teaching sessions at the start of each session in the duration of the game concept development task to clarify concepts, as well as provide feedback to the groups on their progress.

In the first two sessions of the game concept development task, as instructed, students/groups attempted to collaboratively choose their decision-making methods and models as well as formulate the questions that would guide the research for the content that would help solve the
problem on how the citizens in their various models participated in the government decision-making process. Each group blogged about the decision-making methods and models they had chosen and the procedures that were taken for their final decisions on these methods and models. As seen in Table 13, the decision-making method, Majority & Plurality Voting with the Ancient Athens model seemed to be the most popular among the groups with the Majority & Plurality Voting with the Iroquois model being the least popular.

Table 13

<table>
<thead>
<tr>
<th>No. of Groups</th>
<th>Decision-making Methods</th>
<th>Decision-making Models</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>Majority &amp; Plurality Voting</td>
<td>Ancient Athens</td>
</tr>
<tr>
<td>4</td>
<td>Representative Democracy</td>
<td>Ancient Athens</td>
</tr>
<tr>
<td>4</td>
<td>Majority &amp; Plurality Voting</td>
<td>Municipal &amp; Provincial</td>
</tr>
<tr>
<td>3</td>
<td>Consensus</td>
<td>Iroquois</td>
</tr>
<tr>
<td>2</td>
<td>Representative Democracy</td>
<td>Iroquois</td>
</tr>
<tr>
<td>1</td>
<td>Majority &amp; Plurality Voting</td>
<td>Iroquois</td>
</tr>
</tbody>
</table>

Though all the groups had successfully chosen their decision-making methods and models, which was approved by their teachers, it had become evident from their blogs, teachers’ and researcher observations that group collaboration seemed difficult for most of the groups and it appeared to be adversely affecting the groups’ ability to perform their activities. For instance, based on researcher observation guided by the protocol for development and use of 21st century competencies on collaboration and teamwork, students within their groups seemed to encounter challenges in:

- building respectful, caring and effective relationships to manage conflict and differences;
• building respectful and effective relationships to seek consensus in the pursuit of common goals;
• accepting responsibility for their actions as individuals;
• using their influence and powers responsibly;
• keeping the interests of the group in mind (Classroom observation protocol for development and use of 21st century competencies, Appendix F)

To explain this observation, one of the teacher participants, Matt, commented:

You know some kids are just great. They’ve got those skills, they’ve mastered them, they’re naturals, and then there are those that struggle. I need to work with them as far as helping create those collaboration skills, which sometimes you just assume kids have. But what we’ve seen from the feedback they’ve been getting from their peers is that some kids are not a pleasure to work with. They’re not good at communicating their ideas. They’re not effective at collaborating (Teachers’ blog, Mid-interview, April 2014).

Examples of students’ blogged experiences helped to capture their challenges as they attempted to collaboratively participate in their group activities to make decisions in choosing their topics and to brainstorm and agree on ideas for their guided questions:

**Boy WM (6.1):** I am not the best at working in groups. We could not all agree on our topic. That was kind of frustrating.

**Girl SN (6.2):** I think it was difficult to accept other people’s ideas and we were wasting a lot of time coming up with our questions.

**Boy ZE (6.2):** We kinda all just kept arguing to see which topic was the best.

**Girl SO (6.3):** We kept on fighting about things that were not even on topic. We were fighting about cucumbers and how it’s not a vegetable, it’s a fruit, and that does not even make sense.

**Girl OR (6.3):** For 1 hour literally, we were fighting about who gets which question and none of us got any work done and I didn’t really learn anything today. I was just mainly sitting to the side trying to explain and trying to tell them
to stop fighting. We wasted an hour trying to stop people from fighting and telling them this is your question and that is your question or come up with a different question so we could all work together on that question, and it gets really annoying.

**Boy TM (6.4):** My group did not stay on task a lot. We were getting in each other’s ways. We had different ideas for our topic, and it is very difficult to work well together (Kidblogs, March 2014)

Therefore, in sessions 3 and 4, after formatively evaluating the students’/groups’ collaborative issues, in collaboration with the researcher, the teacher participants chose to pause the group work focussed on developing the guiding questions for groups’ research on their topics and instead, aimed to assess group performance earlier in the task, which resulted in the refinement or re-design of the initial sequence of the task’s activities or first iteration of this task. The teacher participants utilized their co-constructed reflection rubric, *Let’s Reflect* (see Appendix L for example of completed reflection by a group member), to allow group members to self and peer reflect on performance and progress within the group, guided by the following four attributes:

**Cooperation:**
1. Do your group members work well together?
2. Do you find solutions when problems arise?

**Contribution:**
1. Do your group members participate in the process?
2. Is each group member “pulling their weight?”

**Communication:**
1. Do your group members express their ideas?
2. Do your group members listen to and consider the ideas of others?

**Collaboration:**
1. Do your group members combine ideas to create stronger ones?
2. Do your group members share the same goals?

The teachers explained to the students that it was necessary to carry out this reflection at this point because without the effective collaboration of groups, it would become even more
challenging to complete their activities and to effectively learn from the process of this task or this experience as they attempted to design and build their games.

During the reflection sessions, all of the groups completed and submitted their reflections to their teachers, who provided constructive feedback (see Appendix M for some examples of this feedback) to each group. To address specific issues, for example, in cooperation, contribution, communication and collaboration, teachers and group members in each group discussed the results of the reflections and collaboratively suggested ways to address issues that were inhibiting the ability of the group to effectively collaborate and work on task activities. The teacher participants also invited the school’s principal to provide and discuss with students some real life experiences on the importance of collaboration to their development and in preparation for the world of work.

Subsequent to this assessment, collaboration within all the groups seemed to steadily improve as the process continued. This improvement can be summarized in two mid-interview responses and a blogged statement by members of three of the groups:

**Group 2 SO (6.3):** Before, it was like we couldn’t even talk to each other for 10 minutes without an argument, or yelling, but after the reflection, we have improved in the way we communicate and cooperate in our group.

**Group 4 BG (6.4):** My group, to be honest, has had their struggles. We were probably the least or the group that could not work well together the most because we had a lot of differences and we just could not put them together. After the reflection, we’ve started to put them aside and we’ve all started to focus on our work (Mid-interview, April 2014).

**Group 2 PH (6.3):** The first time we got our groups, I was so excited and happy that I got to work with my friends and we were all girls. Then we started our project and it didn’t go as planned. But now, after the reflection, we all know how to all work better together and we are way better than we were before (Kidblogs, March 2014)
By sessions 5 and 6, all groups were re-focussed on developing their guiding questions to inform the research of the chosen topics, with the intent to inform the game concepts that would address the given problem. At the start of each of these sessions, using a 15-minute teaching moment, the teachers reviewed some characteristics of effective guiding questions with all the groups and provided them with examples of effective guiding questions, which they also posted in Edmodo for student reference. They explained to the students/groups, that the goal was to have them engaged in actual research and not simple ‘fact finding’.

As the student groups posted their questions in Edmodo, it became evident to both teacher participants and researcher that formulating these questions were proving to be very challenging to some of the groups and in most cases, the questions were not formulated to inform their research. Some groups blogged that they were experiencing difficulty in formulating their questions, while others seemed unclear about the depth of the questions, thus making it difficult to determine the depth of the research that needed to be carried out on their topics:

**Group 1 TN (6.1):** My group is struggling with crafting powerful and developing guiding questions. Making the guiding questions was quite hard for us mostly because our questions were either too complex or too boring.

**Group 1 UM (6.2):** We are having some problems getting our questions deep and ‘nongoogleable’.

**Group 2 NE (6.3):** My group is having a little trouble because we are doing majority vote at a municipal government.

**Group 2 OW (6.4):** This topic is hard because it is difficult to find guiding questions to something you know so much about already (Kidblogs, June 2014)

We (teacher participants and researcher) engaged in some formative evaluation of this issue and realized that the students/groups needed more guided instruction on this activity than initially planned and given. Therefore, in sessions 7 and 8, the teacher participants refined the activity by reviewing the formulation of effective guiding questions with all groups, resulting in
the second iteration of this task. They first used examples of questions that some groups had formulated and then coached students/groups in modifying their questions using the following characteristics of effective guiding questions, as posted in Edmodo:

- A guiding question addresses the ‘heart of the discipline’ being studied. Essential disciplinary knowledge will be required to answer it.
- A guiding question is open-ended, possible to contend, arguable. It must be complex enough to house multiple perspectives and possible answers.
- A guiding question possesses emotive force, intellectual bite, or edginess. Students should be able to engage in quality discussions about the topic.
- A guiding question may lead to new questions asked by the students (Wilhelm, 2007)

Who Cares Test - Moving Beyond Simple Information Gathering to Higher-Level Questioning
1. How is -------- related to?
2. What is a new example of --------?
3. What are some possible solutions for the problem of --------?
4. Explain why --------.
5. What do you think would happen if ---------------------?
6. Why is ---------------- important?

The groups were then allowed to modify their questions, which all received approval by the teacher participants at the start of sessions 9 and 10.

During sessions 7 and 8, the teacher participants also discussed and coached all groups on how to use their guiding questions to brainstorm ideas for their narratives/storylines that will also inform the research needed to develop the game concepts on how the citizens in their various models participated in the government decision-making process. However, through their discussions with the students/groups, students’ reflections in their kidblogs and documented guiding questions and storyline ideas in students’/groups’ Google documents, almost all the groups seemed to have difficulty matching their guiding questions to their narrative/storyline ideas, as seen in the following examples quoted directly from students’/groups’ Google documents (Table 14). The guiding questions did not seem to reflect the narrative/storyline ideas.
Table 14

*Comparison Between Students’/Groups’ Research Questions and Narrative/Storyline Ideas*

<table>
<thead>
<tr>
<th>Topic</th>
<th>Research Questions</th>
<th>Narrative/Storyline Ideas</th>
</tr>
</thead>
</table>
| **Majority & Plurality** | 1. How was the power distributed in the top positions of their democracy and why did the people that had it have it?  
2. How did people get to their position in power, in the position how did that effect the lives of every range and scale in the rank of the people and change the city?  
3. What were the main reasons for the powerful roles in their political structure to help organize the decisions?  
4. How was their social structure incorporated into their democracy?                                                                                   | 1. Our character is going to be a little boy or girl and the more knowledge she gains she gets older.  
2. Our character is trying to solve is rebuilding a city and bring the democratic rights back  
3. The solution to the problem is to embrace and forwards democracy.  
4. This will take place in Ancient Athens.  
5. This game will be operated in the format that were constructing the first democratic city.                                                                   |
| **Ancient Athens**     | 1. How did the power distributed in the top positions of their democracy and why did the people that had it have it?  
2. How did people get to their position in power, in the position how did that effect the lives of every range and scale in the rank of the people and change the city?  
3. What were the main reasons for the powerful roles in their political structure to help organize the decisions?  
4. How was their social structure incorporated into their democracy?                                                                                   | 1. Our character is going to be a little boy or girl and the more knowledge she gains she gets older.  
2. Our character is trying to solve is rebuilding a city and bring the democratic rights back  
3. The solution to the problem is to embrace and forwards democracy.  
4. This will take place in Ancient Athens.  
5. This game will be operated in the format that were constructing the first democratic city.                                                                   |
| **Consensus; Iroquois**| 1. How did the clan mothers choose the chiefs do citizens have an effect on her decision?  
2. How did the clan mother fire the chiefs/what punishment did the clan mother give out if they send terror to the clans?  
3. Did the Iroquois use any other type of decision making other than consensus?  
4. How did consensus making decisions affect their daily lifestyle, hunting, cooking, and chores?  
5. Did consensus work for the Iroquois? If so, why, and how did it make their lives easier?                                                                 | 1. The chief of the Iroquois is the main character.  
2. The chief is trying to help the people in the town make decisions about their town by consensus.  
3. The game is won when all the decisions are made and the people are satisfied and go to back to the Longhouse to celebrate.  
4. The setting of this game is in the Iroquois town.  
5. The player is the chief. The chief walks around trying to find people who are making decisions. When he comes to a person making a decision he helps them to a consensus by solving clues. The game ends when all of the clues are solved, and all decisions are made by consensus. Everyone goes back to the Longhouse to celebrate. |

*(table continues)*
Based on these findings, we (teacher participants and researcher) formatively evaluated the difficulty experienced by many of the groups in an effort to develop strategies to address this learning need. In our evaluation, we agreed that the sequence in formulating the questions, carrying out the research and then brainstorming the narrative/storyline ideas seemed to be contributing to this difficulty. Groups were initially attempting to formulate questions with no idea of what their narratives/storylines would be about—ideas through which they could creatively solve the problem in their games.

The questions were formulated primarily to carry out general research on the topics rather than in connection to a narrative/storyline. This seemed to be an overwhelming task for the students/groups and it resulted in some frustration with the activity. Our following conversation (teacher participants and researcher) served to contextualize the situation—students/groups

<table>
<thead>
<tr>
<th>Topic</th>
<th>Research Questions</th>
<th>Narrative/Storyline Ideas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Majority &amp; Plurality Voting; Municipal &amp; Provincial</td>
<td>1. What is the City and Provincial Structure?</td>
<td>A judge, living in a condo, decides his job is boring, he then runs for mayor.</td>
</tr>
<tr>
<td></td>
<td>2. What are City Rights?</td>
<td>He has to do a job interview, where the character picks the statistics of their profile. He has to talk to people with different interests and choose what to talk about. You need to choose what kind of advertisement you want. He can attend the voting and show the player the voting. Also checking the newspaper could be a mission which would talk about the party that is currently leading. The radio could talk about different complaints the people have talked to the council about. He could go to people and tell them how they can vote. The game could promote being a good citizen and doing your part for the community. He could look at different government facilities and see if they need improvement. (WINNER)</td>
</tr>
<tr>
<td></td>
<td>3. What are Local and Provincial Government Responsibilities?</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4. What Characteristics Local and Provincial Government need?</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5. How can City Protests affect the city choices?</td>
<td></td>
</tr>
</tbody>
</table>
seemed to have no context within which to frame the given problem so they could creatively address it in a story:

**Matt:** What if the next step is that they start thinking of the story that they want to tell. So they’ve gathered these facts. We’re not developing investigations. We’re more finding facts. We need to get them to develop their story ideas then take them back to the questions. How will these questions unload your story? Because I think that might be a bit of a problem because right now they’re mainly fact finding and they’re having a hard time getting out of fact-finding because right now that’s all it is to them. They haven’t picked a storyline or story idea. They need to be getting away from just mainly reading for information on their own.

**Researcher:** If they have a story idea in mind it will help them formulate the questions that will help them to develop that story. How would they try to answer or solve the problem in story form?

**Dave:** They should be focused on building their knowledge guided by a story. Some of them feel that they are just going through the motions of formulating questions about the content they already know and that bugs them. They feel like it’s a waste of time. Some groups are complaining that they already know the topic and need something new to focus on (Planning meeting, Teacher participants and Researcher, March 2014).

Therefore, in agreement, the teachers decided to refine or re-design the sequence of the task’s activities, resulting in the third iteration of this task. The groups were instructed to first brainstorm some ideas for the narratives/storylines on how the citizens in their various models participated in the government decision-making process, then develop questions that would help them to research the content to inform these narrative/storyline ideas.

As students/groups worked with this refined sequence of the task, the teacher participants assessed each group using a formative assessment strategy (as visualized in Figure 1). As groups presented their developing game concepts for green, yellow or red lights, the goal was to provide feedback for improvement and to promote the effectiveness of the task’s activities and by extension, their design principles, in helping students/groups solve the given problem and achieve the learning and intervention goals.
A green light meant that the game concept revealed a very informative and interesting game concept that strongly supports the curriculum content in showing how the citizens in students’/groups’ various models participated in the government decision-making process and some initial evidence of game design principles. A yellow light meant that the game concept revealed an insufficient amount of the curriculum content to show how the citizens in students’/groups’ various models participated in the government decision-making process and little evidence of game design principles. A red light meant that the game concept revealed no evidence of the curriculum content to show how the citizens in students’/groups’ various models participated in the government decision-making process and very little evidence of game design principles.

This formative assessment strategy, which also informed the ongoing analyses of the students’/groups’ activities for improvement and leading to iterations of their game concepts, included weekly assignments in Edmodo, frequent instructional conversations, discussions and/or
Socratic dialogues/questioning between teacher participants and student group members, which also involved a great amount of coaching and scaffolding with teacher feedback, and peer and self-assessments with feedback. In this formative assessment strategy, students/groups were given opportunities to articulate or explain, debate, defend and reflect on their game concept ideas in an effort to stimulate critical and deeper thinking and learning of how the citizens in their various models participated in the government decision-making process.

After the first formative assessment, ten groups obtained a green light, but still needed to refine the presentation of their concepts in terms of clarity for easy understanding, while eight groups obtained a yellow light and two, a red light. Some of the groups’ blogged reflections are included here to help provide some evidence and insights into students’/groups’ performance from their perspectives:

**Group 1 KE (6.1):** My group got a yellow light from [Name of teacher] on our game concept. We had to go back and re-think some details. He also said we needed more knowledge on our topic of the court system. I think our group is heading in the right direction even though we had some obstacles along the road. We need to incorporate how the citizens of Ancient Athens participate in decision making more. We were thinking of incorporating the Assembly, but we realize that it needs to be the court system, to be correct on our information.

**Group 2 KG (6.2):** My group got a yellow light for our concept. We got a yellow light because our concept was not very clear and did not have a base. We did not have one focus for the game and our ideas were spread out too much. Some of our ideas also did not come straight to the point of consensus decision making with the Iroquois. We were told to go back and shape our idea into a more clearer image so that the player would understand what was going on.

**Group 3 YS (6.3):** My group was given a yellow light for our concept. I think that was a good idea, because our group was kind of confused about our concept too, we had so many ideas that it was becoming jumbled in our heads. [Name of teacher] told our group that he was too, confused, and that we weren’t being clear about what our actual concept was.
Group 3 SM (6.1): Well our group didn’t exactly hit the target, we got red. I do agree that we didn’t think through the decision making part in our concept. All we did was create a story that would match modern day. Improvements we will make will be to include a lot more decision making processes in our story. Also we will try to think of something a little more creative and fun for the player.

Group 5 NY (6.1): Our group got a red light because our concept wasn’t researched at all and we were researching a different topic like our topic wasn’t matching what we learned. If we tweaked a little bit of the topic I think, we could get back on track (Kidblogs, March 2014).

The teacher participants continued to formatively re-assess the groups that had received the yellow and red lights as they refined the content for their game concepts until they were approved or got green lights. The teachers reminded each group that the government decision-making process and how it happened had to be based on research and not just what they were able to do when playing the game. They also re-affirmed that one of the goals for the research, in particular, was to engage them in actual research and not just simple fact finding (Teaching moment, sessions 9 and 10, March 2014).

In formatively evaluating and reflecting on the design of their instruction in the entire game concept development task, the teacher participants indicated that, it took some work getting some groups to understand that how the citizens in their various models participated in the government decision-making process is where they need to concentrate their efforts. Some groups became overly focused on the details that led to the problem [and] were creating a game concept that had nothing to do with the government decision-making process in their models (Teachers’ blog, March 2014; Mid-interview, May 2014).

As well as questioning their contribution to this challenge encountered by the groups, Dave also reiterated the iterative nature of the task in helping their students design and construct strong game concepts to inform a deeper understanding of how the citizens in their various
models participated in the government decision-making process as well as the design and building of the games at the potential players’ skills level:

We had to ask ourselves is this a case of us not communicating that or is this a case of them not understanding what was asked of them. So, it’s always going back and doing a little re-changing and guiding them, helping them figure out how their game may be, but at the same time, the focus needs to be the social studies outcomes (Dave, Mid-interview, May 2014).

By session 14, and after three iterations of the game concept development task, all groups had obtained a green light to begin storyboarding their game concepts. Accordingly, Matt blogged:

Ensuring the groups were on track was a very important step in this [task]. Finding out at the end, that some groups’ games were not strong reflections of their understanding was a concern. Now that everyone is on the right path, I look forward to seeing what elements they can add that make the games enjoyable for the user (Teachers’ blog, April 8 2014).

In addition to the iterations that needed to take place in order to achieve the goal of this game concept development task, some modifications to the teacher instructional activities protocol, in particular, became necessary to collect data on the actual instructional activities used by the teacher participants as they provided instruction for the tasks. For instance, sections had to be included to collect data on ‘Teacher-teacher discourse and collaboration’, ‘Formative assessment’ and ‘Feedback’, which were not present in the initial version of this protocol.

**Storyboarding task.** The main goal for the storyboarding task, according to the teacher participants, was for all groups to sketch and organize their game concepts into a sequence of elements that would function as a road map to the actual building of their game prototypes. In so doing, they would continue to communicate a deeper understanding of how the citizens in their
various models participated in the government decision-making process, while also achieving the learning goals of the curriculum unit and other intervention goals—to be intellectually engaged and develop and use 21st century competencies. To initiate the storyboarding task, the teacher participants presented all groups with the following plan, as seen in Figure 12, details of the task’s activities listed in Table 6.

![Figure 12. Initial storyboarding plan](image)

Although some groups had begun planning and discussing the ideas for their storyboards after receiving their green light by session 9 in the game concept development task, the teacher participants collaboratively initiated the storyboarding task in a 30-minute teaching moment with two classes per session (50 students—6.1 and 6.3; 6.2 and 6.4) to explain and discuss the task’s activities that had to be completed in creating or designing and constructing the storyboards. In so doing, they also provided storyboard examples of published games, such as *Star Wars* to help clarify and visualise the storyboard concept. Subsequent to this teaching moment, all groups became fully engaged in brainstorming ideas for their storyboards based on their game concepts and discussing the various responsibilities for their roles in the group. Two groups decided to develop their storyboards on their iPads, while the remaining groups worked on paper.
As some of the groups created their storyboards, particularly in sessions 5 and 6, it became evident to both teacher participants and the researcher that in some groups, members seemed to be encountering difficulty with their role-associated responsibilities—some students appeared to feel that they could more effectively contribute to the creation of the storyboard in a different role or in assisting in other roles. As a result, group members discussed and switched roles, as well as engaged in performing dual roles, which was possible, since in each group, there were members who were multi-skilled in most of the roles, as indicated in the My Learner Profile survey results (see Appendix E). Later on, in the post interview, the students expounded on this situation or experience, (presented in Chapter 5) as one of the ways they developed problem solving skills without their teachers’ assistance.

By sessions 7 and 8, the teacher participants began assessing each group’s storyboard using a formative assessment strategy (as visualized in Figure 13). As groups presented their developing storyboards for green, yellow or red lights, the goal was to provide feedback for improvement and to promote the effectiveness of the task’s activities and by extension, their design principles, in helping students/groups solve the given problem and achieve the learning and intervention goals.

![Formative assessment/feedback/refinement within storyboarding task](image)

Figure 13. Formative assessment/reflection/feedback/refinement within storyboarding task
A green light meant that the storyboard revealed a very informative and interesting game concept (visual or written) that strongly supports the curriculum content in showing how the citizens in students’/groups’ various models participated in the government decision-making process and strong evidence of game design principles. A yellow light meant that the storyboard revealed a game concept with an insufficient amount of the curriculum content to show how the citizens in students’/groups’ various models participated in the government decision-making process and some evidence of game design principles. A red light meant that the storyboard revealed a game concept with no curriculum content to show how the citizens in students’/groups’ various models participated in the government decision-making process and little evidence of game design principles.

As was done in the game concept development task, this formative assessment strategy also informed the ongoing analyses of the students’/groups’ activities for improvement, leading to iterations of their storyboards. It included weekly assignments in Edmodo, frequent instructional conversations, discussions and/or Socratic dialogues/questioning between teacher participants and student group members, which also involved a great amount of coaching and scaffolding with teacher feedback. In this formative assessment strategy, students/groups were also given opportunities to articulate or explain, debate, defend and reflect on their storyboarded ideas in an effort to stimulate critical and deeper thinking and learning of how the citizens in their various models participated in the government decision-making process, their roles, various technologies and game design principles.

After the first formative assessment of the storyboards was completed, in sessions 7 and 8, only five groups received a green light for their storyboards, but it was, according to the teacher participants, ‘under stipulation’, which meant they needed to refine and reduce some of the overwhelming activities in the content. Thirteen groups received a yellow light and two, a
red light. The teacher participants seemed very concerned with the lack of sufficient detail on how the citizens in students’/groups’ various models participated in the government decision-making process in the content of the storyboards—groups were not using their research-informed game concepts developed in the game concept development task as effectively as they could. According to Matt,

The main issue is that they aren’t showing a significant amount of evidence that they have researched the in’s and out’s of their chosen decision-making model. . . Some groups are focused on the lead up to the crucial elements, and not enough detail in the process by which decisions were made. [We are] trying to get them to use the video game concept as a means of communicating their expertise (Teachers’ blog, Edmodo, April 2014). Some of these storyboards were 80% sort of bleed up fun; they weren’t really steeped in the social studies content (Mid-interview, April 2014).

Therefore, we (teacher participants and researcher) engaged in some formative evaluation of this issue and realized that the students/groups needed more guided instruction or coaching in incorporating the curriculum content from their game concepts into their storyboards than initially planned and given. Therefore, in sessions 9 and 10, the teacher participants refined or re-designed the activity, resulting in the first iteration of this task. They provided some guided instruction, in a 30-minute teaching moment to all the groups, on how to incorporate the curriculum content from their game concepts into the storyboards and continued with further discussions and coaching, with detailed feedback, to assist individual groups in making the content of their storyboards “more indicative of [groups’] level of understanding and less of just a game that kids play” (Matt, Mid-interview, April 2014). Examples of the detailed feedback provided to three of the groups, in Edmodo, are as follows:
I feel like your game doesn’t communicate a deep and expert understanding of the government decision-making process as it pertains to the Assembly. Your game character enters the Assembly, sits down and votes. There’s more to the process than that. Use the research you compiled in your game concepts and find ways of fitting it in. Eighty percent of the game should be about the Assembly, not riding a horse. As we discussed, you need to focus your efforts on the portion of the story that pertains to the decision-making process. I would shorten the part about the hostage taking, and get right to the good stuff about the Pnyx.

What I see is a very basic outline of how bylaws come into existence. You have skimmed over the process. There’s more to the process that needs to be brought into your storyboard. Use the research you have compiled in your game concepts. Also, wouldn’t it be awesome if you had more player involvement in the process?

You guys are on the right track, but I think you are missing the boat a little. You got your character to the Assembly, so that’s great. Now, the big part, is really impressing your player with the process that happened once an issue was presented in the Assembly. That’s what will educate your player on the way the Assembly worked. (Teacher feedback, Edmodo, April 2014).

As groups refined their storyboards based on teacher feedback, the teacher participants formatively evaluated the types of activities that they had initially planned to help students/groups continuously refine their storyboards in order to reflect or communicate their deep understanding of how the citizens in their various models participated in the government decision-making process. They realized that students/groups needed more authentic opportunities, within and across groups, to think about, assess and refine their storyboards to
reflect that deep understanding. Therefore, they refined or re-designed the plan to include self and peer assessment opportunities, resulting in a second iteration of this task.

In sessions 11 and 12, the teacher participants utilized what they termed, an ‘elevator pitch’ in order to help each member in the group deeply reflect and self-assess the strengths and/or weaknesses of the design and content of their storyboards. This ‘elevator pitch’ was guided by the following questions:

1. What information does your player learn by playing your game?
2. What are the strengths and weaknesses of your game’s content?
3. Does your game’s content accurately reflect your own personal understanding of the topic? Explain.

Students were instructed to choose only one of these questions to answer in a one-minute video recorded on their iPads (see Appendix S for samples of these videos), which, when submitted received teacher feedback, along with a grade, on the details and explanations given, as well as on how well they articulated the ideas they shared with their teachers. Based on the feedback provided by the teacher participants, they seemed quite impressed with each student’s performance in terms of the detailed and honest explanations they provided, as well as the articulation of their ideas, resulting in all students being graded ‘Great Job’. Students used their reflections on the videos and feedback from their teachers to inform the continued refinement of their storyboards.

In sessions 15 and 16, the teacher participants provided groups with the opportunity to share and assess their storyboards, across groups and classes, for feedback from their peers by allowing all groups to participate in ‘group-share reflections’—groups were purposefully peered to review and provide constructive criticism and feedback to each other on their storyboards. From classes 6.1 and 6.3, and 6.2 and 6.4, respectively, the two girls’ groups; two boys’ groups,
groups’ 3s, 4s and 5s were paired for this activity. The group-share reflections were guided by two questions:

1. What are we going to learn as a user of this game?

2. Is the storyboard focused on decision making or on something else?

To initiate this activity, in 15-minute teaching moments with two classes per session (50 students—6.1 and 6.3; 6.2 and 6.4), the teacher participants first reflected on groups’ overall performance on the storyboarding process and then provided some guidance in carrying out the group-share reflections. In reflecting on groups’ overall performance, teacher participants informed groups that, at that point in the process, there were no red lights, which was a great improvement from sessions 7 and 8, and that some groups with yellow lights still needed to clarify the main part of their games as it was still ‘foggy’. Some groups still needed to broaden the scope of their content on how the citizens in their various models participated in the government decision-making process, while some had the tendency “to go really complicated with the game concept” (Conversation with groups in Teaching moment, sessions 15 and 16, April 2014).

Whether they had received a green or yellow light, the teacher participants coached and advised groups on the continued refinement of their storyboards, which they should also take into consideration in the group-share reflections:

Everything you do as you design and complete your storyboards, ask yourself the question: Is this communicating our understanding of the government decision-making process? Put your effort where it matters most, that is, in showing us and the people playing the game that you are experts on how decisions were made in your chosen model. That’s why you did all that research you got; it’s time to let that research in. . . Picture your storyboard as a blue print for your game activity. Anyone who is not in your group
should be able to look at your storyboard and understand what it is you are trying to accomplish (Conversation with groups in Teaching moment, sessions 15 and 16, April 2014).

Teacher participants then explained the procedure for the group-share reflections and also challenged students to “simulate ways that would depict constructive feedback in a nice way” to each other (Conversation with groups in Teaching moment, sessions 15 and 16, April 2014). In short, the teachers reminded groups that in providing constructive criticism to peer groups, they had to keep in mind that they were talking to each other and could say, “explain this a little more to me because maybe it might make perfect sense to them and so, instead of telling them that they’re wrong, you’re instead asking them for help. That’s a nice way to do it” (Conversation with groups in Teaching moment, April 2014).

That being said, groups were asked to work on their storyboards for 30 minutes and then paired with other groups for a 10-minute group-share reflection. At the end of the group-share reflections, teacher participants assessed each individual student in terms of his/her positive contribution to the group-share reflection experience:

You are going to take one minute to think, out of the 9 other people, who do you feel . . . really tried hard to make this a valuable experience? What we’re going to do is when I start counting down from 5, you got to make up your mind. When I get to zero, you’re not going to say anything, but you’re just going to point your finger at the person you really think stood out as somebody positive in this process. If you have no fingers pointed at you, that’s an issue. If you have a finger pointed at you, good for you. (Conversation with groups in group share reflection session).

This was also an informal way of peers assessing each other’s contribution within and across groups and providing accountability on the four attributes: Cooperation, Contribution,
Communication and Collaboration. Students felt it was a fun way to assess each other’s performance. Using the feedback from their teachers, videos (self-assessments) and group-share reflections, all groups continued to refine their storyboards. By April 30, sessions 17 and 18, and after two iterations of this task, all groups had received the green light for their storyboards to move to the programming task. In concluding the storyboarding task, the teacher participants reminded all groups that their storyboards were just theories of what they wanted their games to look like, and there was a possibility for them to change or be modified as the programmers coded the games.

At this point, mid-interviews, which were developed during the game concept and storyboarding tasks and mainly informed by the observation findings guided by the observation protocols, teachers’ blog, Kidblogs teachers’ documents and student game artifacts (game concepts and storyboards) were carried out with the teacher participants and four groups of six students each, randomly selected from each group in each class (6.1, 6.2, 6.3, 6.4). This interview aimed to collect data that would help to address the research questions. The analysis and results from these interviews are presented in Chapter 5.

**Programming task.** The goal of the programming task, according to the teacher participants, was to allow students/groups to bring their game concepts/storyboards to “. . . life and to give the content they’re learning some spirit” (Mid-interview, April 2014), while achieving the learning goals of the curriculum unit and intervention goals. In preparation for the programming of the games, using the iMacs in the library, the programmers from each group were given 35-minute warm-up sessions on Scratch, during which they tested the software by coding very simple animations and seemed to be a fun practice experience for the programmers.

Meanwhile, other group members, in the classrooms (downstairs), collaborated to discuss and plan their specific contributions, based on the storyboards, to the programming of their
games. Then in the first session of the programming task, as presented in the plan in Figure 14, the teacher participants collaboratively held an introductory 15-minute teaching moment with two classes per session (50 students—6.1 and 6.3; 6.2 and 6.4) to explain the task’s activities that needed to be completed to program students’/groups’ game concepts.

Subsequent to the teaching moment, the teacher participants used a more hands-off approach in the programming task. Matt explained that this approach resulted from the fact that they were not as skilled in using Scratch as their students and it was to encourage a more authentic collaborative experience for [the students]. They have the skills and they have the content, they have the knowledge, so it’s time for them to show and communicate their understanding of the government decision-making process in their chosen methods and models (topics) without teacher instruction and through something other than just a simple paragraph or essay format—the Scratch platform. We have to be clear on what their understanding is regardless of how the video game turns out . . . the
game itself is the icing on the cake. We won’t be assessing the game (Mid-interview, April 2014).

As such, the programming task was more student-centred and managed. The teacher participants mainly focused on ensuring that the groups’ members in the classroom remained on-task. They also provided some constructive criticism and guidance to group members as they engaged in their specific roles, to prepare and submit the information (art, dialogues and music/sounds informed by the storyboards) needed by their programmers to code and build the games. The specific activities performed by members of each group based on their roles were summarized in Table 7 as blogged by the groups. When questioned about the absence of their teachers’ instruction during the task, some programmers commented:

**Programmer WP (6.1):** It worked well because the teachers had already given us the guidelines and it was our decision to take the guidelines and make them into something.

**Programmer OR (6.3):** It just worked fine because our teacher did a really good job at explaining it.

**Programmer UR (6.4):** I, actually did not notice that he was gone. When I did notice, it was nice because there was a bit of freedom, so I liked it in that case (Post interview, June 2014).

During the initial sessions of the programming task, it became obvious that the distance between the programmers and their group members seemed to pose a challenge to their communication and collaboration. Groups, therefore, used creative measures to address this challenge by setting up web conferencing via FaceTime and using iMessages to communicate and collaborate with their programmers. In the first two sessions, these forms of communication seemed to work, but groups began encountering difficulty with their connections and decided on another way to work with their programmers.
Depending on the activity the programmers were focused on, the group members with the specific skills would join the programmers to work on that activity. For instance, when the programmers were focused on drawing the backgrounds, characters and other visuals, the artists would join the programmers to complete that activity, and so on. This form of communication and collaboration continued throughout the programming task (42 sessions within an 8-week period), but groups continued to be challenged by that distance.

During the first six sessions of the programming task, programmers also encountered some setbacks with the hardware. In some instances, it took programmers at least 10 to 15 minutes to login on the iMacs and another 10 minutes to load Scratch, leaving them with approximately, 15 minutes to work on their programming, resulting in some student frustration. The teacher participants, with the assistance of the professional development leader, tried to address this issue by servicing the iMacs through technical support and making an extra iMac available to the programmers in the event it was needed.

As programmers continued to build and test the first prototypes of their games, guided by the game design principles, they heavily depended on a peer assessment/reflection/feedback/test/refinement strategy (as seen in Figure 15), which informed the ongoing analyses of the students’/groups’ activities and leading to iterations of their game prototypes.

*Figure 15. Peer assessment/reflection/feedback/test/refinement within programming task*
Matt explained that as the groups used this strategy to continuously refine the prototypes being built, his feedback on student/group progress could not be as forthcoming until the first prototype was completed—“until it’s quite finished, I don’t think there’s really a lot I could see or even give feedback on” (Post interview, June 2014). Dave added that the feedback given was mostly informal, “like let’s see where you’re at now” (Post interview, June 2014). Providing constructive feedback was also very challenging for the teacher participants at this stage because as explained by Matt, they were dealing with technological difficulties and having the classes all over [in the library and in the classrooms downstairs], it’s hard to sort of manage our time in that way because we can’t be up here working with the students, and we have a class of students downstairs also needing assistance (Post interview, June 2014).

He reiterated that during the programming task,

it’s less direct instruction and much more of individual feedback groups with each group. It’s kind of like they’re in that building phase and that’s it. So my job can’t be to jump in and get to prescribe everything. It’s about them fine tuning and giving feedback and making it more effective (Post interview, June 2014).

Towards the end of May, by sessions 19 and 20, two weeks away from the stipulated deadline to complete their games, the status of all of the game prototypes indicated that none of the groups were near completion of prototype 1. Programmers complained that the 35 and 30-minute sessions were insufficient in meeting that deadline. The teacher participants, with the assistance of the professional development leader, discussed and evaluated this and other issues, for example, groups’ access to more hardware and the distance between the programmers and their group members. They addressed these issues by increasing the amount of time from 35 and 30-minute to one-hour sessions, provided reserved laptops from the library to accommodate this
increased time so that 10 programmers could work per session with all their group members, instead of the original five, by themselves, and extended the deadline for completion of, at least, the first prototype to June 25. This resulted in the first iteration of the design of this task. These technical changes helped to speed up the task, but some programmers felt that they were being rushed and this was negatively impacting the quality of their games:

**Programmer VN (6.1):** We were getting kind of rushed towards the end and when we were rushed, we were not producing very good work and that would make us have to do it again.

**Programmer YS (6.3):** When we were rushing near the end, we were not producing our best work. We had to go over it and we ended up wasting more time rushing than we would have at a normal speed (Post interview, June 2014).

The programmers also complained that some of the setbacks resulted from the slow pace in receiving some of the artwork, in particular, in creating and importing music from the iPad to the iMacs, slow Internet connection, limitations of the Scratch software in coding and scripting some of their ideas, group members going off task and the continued challenges of the distance between the programmer and the rest of the group. Despite these setbacks, groups were motivated to complete prototype 1 and some programmers worked extra hours at home.

By June 25, sessions 41 and 42, three groups indicated that they had completed the first prototype of their games. Members from two of the groups explained:

**Group 1 UR (6.4):** Our group finished. We actually just finished today. I’m really happy that we’re finished. Like F said, we had a lot of difficulty at the beginning, but after a while we kind of learned to work with each other. We had a group of people who didn’t really work well together, but we were able to work it out. We had to switch up roles and stuff to make sure everything was going smoothly and eventually we were able to finish. I think we have a good product and I’m happy about it.

**Group 4 TM (6.4):** My group completed our game. I think the main reason is because we had scripts that was basic and our game wasn’t very long in length. But we did it. We made a game, we put in all the
information we wanted to put in, and then we completed the game a few days earlier than everyone else. I think it was an efficiency thing (Post interview, June 2014).

The three groups tested and tried out their prototypes with their peers, within groups, teachers and researcher, mostly for their usability—the game being easy to use so that the player can focus on the objectives of the game with little or no frustration; game functionalities easy to learn; no errors in interactions and navigation; inclusion of a user guide, tutorial or helpful prompts/hints and matching players’ skill level. It became obvious that there were a few glitches that they needed to be fixed before the prototypes could be reviewed for further refinements or modifications.

During the post interview, which was carried out on June 19, 20 and 24 with four groups of six students each, randomly selected from each group in each class (6.1, 6.2, 6.3, 6.4), students were questioned on the status of their game prototypes. Those who had not completed their first prototypes, at first seemed embarrassed to respond to the questions. Therefore, I needed to encourage them to talk about it, as well as indicate to them that they did not have to be embarrassed about not completing their first game prototypes. That said, students began opening up about their incomplete game prototypes. Two indicated that they were about 95% complete; six, about 90% complete; three, about 85%; four, about 70% complete and two, about 60% complete and needed at least, two to three weeks, to complete their first prototypes, which they believed was possible.

In summing up his impression of the groups’ performance in the building of their games, and which seemed apparent in the stages of completion of students'/groups’ first game prototypes, Matt commented that, “Some students seem able to construct elaborate games, while others were still struggling with the basics” (Post interview, June 2014). However, he indicated that although they were “very interested to see these games and to see how students will
communicate what the plans said the game would communicate” (Mid-interview, May 2014), they were placing more emphasis on the “skills that it took to get to this point and the task” (Post interview, June 2014).

To complete their implementation of the learning tasks, the teacher participants summatively assessed individual students’ overall performance within all the learning tasks by using a final reflection rubric, guided by the following questions:

1. How did you feel when you first received your assignment? Why?
2. How has your understanding of the role changed over time?
3. What was one area of challenge relating to your role that you overcame? How did you move past this challenge?
4. How does your final product reflect your skill and expertise regarding your role?
5. What are you most proud of in your final game?
6. If you could go back and do it all again, what would you do differently in your role?
7. How effective have you been in your assigned role for your scratch group?

The blogged responses to these questions (see Appendix T for samples of these responses) were used as an additional data source to analyze the impact of the design and building of the video games on students’ intellectual engagement, deep learning of the curriculum content and the development and use of 21st century competencies.

**Assessment Phase—Evaluation and Reflection**

The assessment phase or evaluation and reflection phase “constitutes one (empirical) micro-cycle” (McKenney & Reeves, 2012, p. 80) and represents the final phase of the DBR process. The purpose of this phase, as employed in this research study, is to assess/evaluate and reflect on (i) the potential and effectiveness of the design and building of video games as an
innovative pedagogy that could intellectually engage students in deep learning of curriculum content and promote their development and use of 21st century competencies, thus attempting to address one of the main challenges faced by K-12 educators and the problem that initiated this study; and (ii) its effectiveness in possibly addressing some of the concerns/unplanned effects and gaps identified in past research studies, in and beyond the school context. This assessment/evaluation and reflection are informed by the findings resulting from its exploration in the prototyping phase of the DBR process (presented in Chapter 5), and discussed in Chapter 6.
Chapter 5: Findings

Introduction

Throughout the game concept development, storyboarding and programming tasks, I collected and compiled data informed by the observation protocols (teacher instructional activities, deep learning, intellectual engagement and development of 21st century competencies), teachers’ blog, Kidblogs, teachers’ documents, student game artifacts and interviews with student and teacher participants. An analysis of the data enabled the research team to gauge the effectiveness of the tasks’ activities in meeting the learning and intervention goals, and also informed the iterations or changes/modifications to some of the teachers’ design of instructional activities and learning tasks’ activities, as described in Chapter 4. In this chapter, an analysis of the collected data will help to address the following questions that guided this research, in an effort to also assess/evaluate and reflect on the potential and effectiveness of the intervention as an innovative pedagogy that can possibly help to address the problem that initiated this research study:

1. In what ways do teachers’ design of instruction and learning tasks need to shift when designing and building digital video games to intellectually engage students in deep learning of curriculum content and to develop and use 21st century competencies in school?

2. In what ways does the design and building of digital video games in school impact students’ intellectual engagement, deep learning of curriculum content and the development and use of 21st century competencies?

To address these research questions, the analysis of the collected data was mainly informed by (i) an adaptation of Ritchie and Spencer’s (1994) framework analysis in which a
priori and emergent coding approaches were used to categorize the data into themes/topics; and (ii) an adaptation of Moustakas’ (1994) development of textual description of participants’ emerging experiences (as described in Chapter 3). The findings resulting from this analysis are supported by direct quotes from the interviews with respondents (teacher and student participants), transcribed audio-taped discussions, instructional conversations and teaching moments, excerpts from the Kidblogs, students’ Google documents, students’ self-assessments, peer assessments, teachers’ documents (assessment rubrics, feedback), video-taped group activities and student game artifacts (game concepts, storyboards and game prototypes).

As such, these findings are presented in five sections: (i) Teacher participants’ shifts in design of instruction and learning tasks; (ii) Impact of the design and building of digital video games on students’ deep learning; (iii) Impact of the design and building of digital video games on students’ intellectual engagement; (iv) Impact of the design and building of digital video games on students’ development and use of 21st century competencies; and (v) Impact of the design and building of digital video games on the interconnection between deep learning, intellectual engagement and 21st century competencies.

**Teacher Participants’ Shifts in Design of Instruction and Learning Tasks**

For the purpose of this research, shifts in teacher participants’ design of instruction and learning tasks will be taken to mean or include modifications/refinement of the instructional activities (see Table 11 and Figure 16) and design principles that guided the learning tasks’ activities/ideas (see Table 12 and Figure 20). As such, shifts will be considered on two levels. On one level, shifts will include modifications/refinement of the instructional activities as teacher participants would normally use them in their social studies classes, to some extent, to teach the same chosen content.
On another level, shifts will include modifications/refinement of the instructional activities and design principles that guided the specific learning tasks’ activities/ideas during their implementation, in teacher participants’ attempt to achieve (i) the learning goals—to recognize how individuals and governments interact and bring about change within their local and national communities, to demonstrate an understanding of the fundamental principles of democracy and to analyze the structure and functions of Alberta’s provincial government; and (ii) the intervention goals—to intellectually engage students in a deep learning of the decision-making process in Ancient Athens, Iroquois Confederacy and Municipal and Provincial [current era or modern day]) as well as encourage the continued development and use of 21st century competencies. Based on researcher observation, evidence of teacher participants’ use of the instructional activities and design principles to guide the learning tasks’ activities/ideas in the game concept development, storyboarding and programming tasks are presented in the following Figures 16-20.

*Figure 16. Radar graph showing evidence of teachers’ use of instructional activities during the implementation of the game concept development, storyboarding and programming tasks*
Overall, as depicted in Figure 16, the researcher’s observation of teachers’ use of instructional activities to support students’/groups’ design and building of their video games in the three learning tasks indicates that most instructional activity was evident during the storyboarding task, while the least instructional activity seemed evident in the programming task. More specifically, throughout the initial game concept development task, as also seen in Figure 17, the data indicates that teacher-teacher discourse and collaboration and teacher-student discourse and collaboration were evident throughout the task (in all 14 sessions), closely followed by seeking various modes of problem solving, pedagogical content knowledge, formative assessment and feedback (in 12 of the 14 sessions), while reflective learning and conceptual thinking were the least evident (in 8 and 7 of the 14 sessions, respectively).

![Teacher Instructional Activities in Game Concept Development Task (n=14)](image)

Figure 17. Bar chart showing evidence of teachers’ use of instructional activities in the game concept development task according to sessions.
Throughout the storyboarding task (as also seen in Figure 18), the data indicates that all of the instructional activities were evident (in all 18 sessions). The data also indicates that throughout the programming task (as also seen in Figure 19), there seemed to be less instructional intervention by the teacher participants.

Figure 18. Bar chart showing evidence of teachers’ use of instructional activities in storyboarding task according to sessions

Figure 19. Bar chart showing evidence of teachers’ use of instructional activities in programming task according to sessions
More specifically, the only instructional activities that seemed evident throughout the task (in all 42 sessions) included seeking various modes of problem solving, reflective learning, intellectual rigor, constructive criticism, and the challenging of ideas, connections between content and real life/world situations and teacher-teacher discourse and collaboration. Explicit conceptual thinking and instructional strategies and activities to probe students’ existing knowledge and preconceptions seemed non evident, while divergent thinking, pedagogical content knowledge, coaching and scaffolding, teacher-student discourse and collaboration, formative assessment and feedback were somewhat evident throughout the task.

Overall, as depicted in Figure 20, the data also seemed to indicate that as teacher participants implemented the learning tasks, all the design principles used to guide the design of the tasks’ activities seemed evident.

![Radar graph showing evidence of the design principles guiding activities/ideas in the game concept development, storyboarding and programming tasks](image)

*Figure 20. Radar graph showing evidence of the design principles guiding activities/ideas in the game concept development, storyboarding and programming tasks*
Actual Shifts

Based on these findings, which were shared with teacher participants during the study, I used the mid- and post interviews to identify and confirm with them, the specific ways, if any, that they needed to shift or modify/refine their instructional and learning tasks’ activities, as they implemented the learning tasks to meet the learning and intervention goals. In their responses, teacher participants seemed to identify mainly instructional activities that needed to be modified/refined to meet the learning and intervention goals. Some of the main shifts identified included: a more complex interactive learning community network—multiple interaction modes for collaboration and communication, more extensive use of coaching and scaffolding, process/context-dependent assessments with feedback loops, more extensive use of conceptual and divergent thinking and increased theoretical support for the design of learning tasks’ activities.

These shifts in instructional activities also resulted in emerging design principles to guide the design of some of the tasks’ activities, for example, deeper collaboration, communication and interactivity, authentic context-specific assessments, more intense mentoring and increased theoretical support. The systematic analysis of the collected data and the results of continuous formative assessments informed these shifts. These assessments were carried out by the teachers through regular assignments on Edmodo, within frequent instructional conversations, discussions or Socratic dialogues/questioning between teacher participants and students/groups, students’/groups’ reflections in their Kidblogs and teacher feedback. The shifts seemed to be directed mainly towards encouraging students’/groups’ deep learning of the curriculum content as they designed and built their video games to communicate their deep understanding of how the citizens in their various models participated in the government decision-making process.
There seemed to be a more indirect encouragement towards intellectual engagement and development and use of 21st century competencies as teacher participants stated that intellectual engagement and the development of 21st century competencies were already inherent features/characteristics or by-products of the design and building of digital video games—naturally ingrained within that context. A detailed analysis of the main shifts is presented according to the identified themes/topics and significant verbatim responses by teacher participants and, in some cases their students, during the mid- and post interviews.

**A more complex interactive learning community network with multiple interaction modes for collaboration and communication.** During our planning meetings before the implementation of the learning tasks, in discussing teacher participant instruction during the learning tasks’ activities, one of the teacher participants, Matt, stated that his interaction with the students in the learning tasks would be quite limited. He explained, “I would rather, instead of me guiding them along the way, I’d like to give them the opportunity to pursue it on their own, knowing what they do know, and then I’ll just sort of be there to give them that push if they need it” (Planning meeting, October 2013).

However, with subsequent planning of the game design unit plan (see Appendix J) and our collaborative framework for the design and implementation of the intervention in the prototyping phase of DBR process (see Table 10, Appendix N), Matt indicated that he learned that the teachers “could not just back away, stand off to the side or front of the class at [their] desks”, and allow the students to discover for themselves ways to solve the given problem through video game design and building in an “almost unplanned fashion” (Mid-interview, April 2014). Matt realized that the teachers needed to be “very involved in shaping and interacting with the students/groups, content, technology and each other” (Mid-interview, April 2014). He
learned that his teaching had to be more intentional and responsive to what the students were learning.

The teacher participants explained that as part of their design of instruction in their social studies classes, it was customary for them to collaboratively plan the unit, then interact with their students through mostly guided teaching sessions, while allowing them to work on projects, either individually or in groups, to apply and show their understanding of the curriculum content. This interaction mostly comprised teacher-teacher (mainly to plan units), teacher-student and/or teacher-group modes of interaction.

Therefore, in their initial design of instruction for the implementation of the learning tasks, they tried to imitate similar interaction modes, teacher-teacher (to a small extent or when necessary), teacher-student and teacher-group modes for collaborating and communicating during each learning task. However, as they implemented the learning tasks, particularly the game concept development and storyboarding tasks, the teacher participants indicated that they needed to employ more interaction modes to collaborate and communicate during these tasks in their effort to mostly promote students’/groups’ deep learning of the curriculum content and to facilitate the designing of their games in preparation for their building during the programming task. These interaction modes are depicted in Figure 21.

![Diagram](image)

*Figure 21. Interaction modes for collaborating and communicating during learning tasks, adapted and modified from Moore’s (1989) three types of interactions in an online course*
**Teacher-students’/groups’ interaction.** As was described in the game concept development and storyboarding tasks and, to some extent, in the programming task (see Chapter 4), as well as depicted in Figure 16, there seemed to be continuous teacher-students’/groups’ interaction. Matt explained that one of the reasons for their continuous use of this interactive mode was that unlike other projects that he had facilitated in the past, this project did require more extensive and frequent teacher-students/groups discourse/communication and collaboration—teaching moments, instructional conversations, discussions, Socratic dialogues/questioning and feedback and “at a much deeper level to an extent” because he didn’t want to see groups “creating a game that [didn’t] honor how much they know” (Teachers’ blog; Mid-interview, April 2014).

Dave also stated that this was a way to ensure that “Everyone [was] doing what [he/she] should be doing on their progress route” and this helped to reinforce the “fact that they’re responsible for their ideas and for getting those ideas into their games” (Mid-interview, April, 2014). Matt further explained that in this type of context, it became more and more important for them to “do check ins very frequently and through multiple different ways like through the blogs and through quick chats and the feedback sections they have to submit” (Teachers’ blog; Mid-interview, April 2014).

In describing this type of interaction with his teacher, one student stated that discussing their game concepts and storyboards with their teacher gave his group “more confidence to turn out an overall better project” (Mid-interview, April 2014). Another student described that interaction using the following analogy: “if our group was in a car driving on the road and we are veering off, that’s our work. He would jump in the car and help us steer it in the right direction” (Mid-interview, April 2014).
However, during the implementation of the programming task, teacher-students’/groups’ interaction seemed to diminish, to some extent (as described in Chapter 4 and depicted in Figure 16). The teacher participants explained that this may have occurred because, based on the results of the formative assessments in the game concept development and storyboarding tasks, they were convinced that students/groups had the skills, content and knowledge to “handle this [task] well on their own” (Matt, Post interview, June 2014).

Within this teacher-students’/groups’ interaction mode, teacher participants encouraged more students’/groups’-students’/groups’ interactions (student-student, student-group and group-group), which were greatly influenced by students’ roles (story writer, artist, programmer, musician/sound engineer, leader) within each group. The teacher participants explained that this interactive mode represented a shift from the way they would normally group their students to work on projects. For instance, in previous group projects, group members were allowed to choose the way they wished to communicate their understanding of the given curriculum content. According to Matt, “Typically for us we would say choose a way to communicate your knowledge from whatever options you want” (Pre-interview, October 2013).

However, in this game design and building process, it became necessary for the teacher participants to choose the way—design and building of video games using Scratch, and to create groups with assigned roles because, according to Dave, “It had to be intensive group work” (Mid-interview, April 2014). Matt further explained,

We’ve had to use extensive student-student and group-group discourse and collaboration in this game unit. We’re asking them to create ideas, deliver those ideas, do the research, everything along the way has been group. Very little has been teacher-led and very little has been independent. It’s been intensive group work. For us, the real emphasis was the collaborative aspect of it all. You know, having those assigned roles, and helping kids
keep working forward, even though they feel that their role is finished, I think was where I had to really adapt my strategy: how can I keep them moving forward (Mid-interview, April 2014).

Dave also felt that “the kids [were] getting a lot out of it from that aspect—just learning how to work as an effective group” (Mid-interview, April 2014).

As they continued into the storyboarding task, the teacher participants also indicated that they found it necessary to design new ways or “more authentic collaborative experience[s]” to help students collaborate and communicate with their peers as their understanding on how the citizens in their various models participated in the government decision-making process continued to emerge. As such, they explained that they promoted more group-group interaction through ‘group-share reflections’—groups were purposefully peered to review and provide constructive criticism and feedback to each other on their storyboards (as described in Chapter 4).

The teacher participants stated that this peer reviewing was a strategy to help groups refine their activities and to encourage a deeper understanding of how the citizens in their various models participated in the government decision-making process. It also provided opportunities for them to be intellectually engaged in their learning as well as develop and use 21st century competencies, specifically, their decision-making and collaborative skills to reflect real life situations. They also stated that this type of interaction was necessary for them to “learn more about the progress of each group, identify misconceptions [student/groups] still had about the [curriculum] content and the tasks’ activities and to offer suggestions for next steps” (Matt, Teachers’ blog, April 2014; Dave, Mid-interview, April 2014).

Students/groups also indicated that this interaction with their peers was especially valuable for them during the process, as captured in the following comments made during the mid-interview:
**Girl ZJ (6.1):** I find it better working in groups in this project because we have roles to do. So everybody has to do something and you can’t really get out of it.

**Boy UD (6.3):** So working in this group for this project is probably better to learn and understand the decision-making process than working alone.

**Boy CN (6.4):** We all have different levels of understanding so we all know a bit more and sometimes a bit less. So we all like learn from each other (Mid-interview, April 2014).

**Teacher-teacher interaction.** Teacher-teacher interaction was evident throughout the implementation of all the learning tasks, as depicted in Figure 16. Matt stated that this mode of interaction needed to be “extensive because this is a challenging context” and Dave added that it “greatly enhanced the process” (Mid-interview, April 2014). Matt further explained its significance in designing their instruction as they implemented the learning tasks:

> It’s a heavy unit and we have had to really be in tuned with what it is we are really striving for because you could get lost. You know, teachers could get lost in this one, I think. But you have a clear idea of where you’re going if your partner is there to help stir the ship as well, to balance ideas off of [sic]. A lot of it’s been thinking on our feet as well. Do we see it going this way? Do we like it going that way? If we don’t, how do we get it back this way? It’s been a very intensive collaboration. I think since I’ve been at [name of school], this one’s been the most collaboration I’ve had with a partner (Post interview, June 2014).

In support of Matt’s explanation of the significance of their collaborative teaching and planning, Dave added, “doing this on my own would have been very difficult and very frustrating. You know there is some difficulty and frustration and it’s a lot easier when it’s shared. We were both more engaged in our teaching because of that collaboration” (Post interview, June 2014).
**Teacher-content interaction.** The teacher participants explained that as the curriculum content experts, they needed to interact with the curriculum content more extensively during their implementation of the game concept development and storyboarding tasks as they negotiated that content with students/groups. This negotiation, they stated, was to help students/groups learn and understand the curriculum content at a deeper level by communicating a deep understanding of how the citizens in their various models participated in the government decision-making process through deep thinking and analysis rather than merely memorizing and recalling facts (Mid-interview, April 2014).

The teacher participants also explained that they particularly interacted with that content during (1) each teaching moment, as Dave described, “starts kind of fairly guided and then becomes really hands-off along the way and then challenging” (Post interview, June 2014); and (2) formative assessments as they provided continuous assignments in Edmodo, frequent coaching and scaffolding through instructional conversations, discussions and/or Socratic dialogues/questioning with the students/groups, responded to students/groups’ reflections in their Kidblogs, and provided them with frequent and continuous feedback for refinement of their ideas and artifacts (mostly game concepts and storyboards). Matt described this interaction and collaboration with the curriculum content as “pretty intense to see how well [students/groups] were doing in a modern unit” (Mid-interview, April 2014).

The data also seemed to indicate that the teacher participants tended to spend a considerable amount of time interacting with the content in the game concept development (14 one-hour sessions) and storyboarding (18 one-hour sessions) tasks because, as stated by Dave, it was important for all the students/groups to “garner all the information that they needed, and then sorting it out and then finding a story in it, [which] was onerous, but valuable” (Teachers’ blog, April 2014). Matt also explained that this amount of interaction with the curriculum content was
necessary because he found that there were some groups that needed to go back and think of ways to incorporate more of the curriculum content into their game concepts and storyboards:

Once I felt that they had enough ‘meat’ that’s when they were able to go forth and turn it into a game. So it was a lot of meetings with the groups and talking it out and really coming to the understanding that there is enough of a [sic] content in here (Mid-interview, April 2014).

Dave added that in interacting with the curriculum content through their conversations/discussions during the formative assessments, they were also able to encourage students/groups to “figure things out as they go and to kind of construct their own understanding based on information they learn from us” (Mid-interview, April 2014).

**Teacher-technology interaction.** The teacher participants indicated that in designing instruction for all their social studies classes, they also tried to make use of various technologies as much as they could “without over using it”. According to Dave, “We recognize that sometimes, technology is not just the best option, but we try to take advantage of the type of world that we live in now and the type of world that we think that the students will be living in the future” (Pre-interview, October 2013). He identified some of the technologies that they used:

We use lots of collaborative software like google drive that allows you to work with multiple people on one account. Edmodo is a really popular management system. We use iMovie—it is very popular. Then there is lots of social media tools like twitter, EverNote which is a really popular way to keep things organized, interactive whiteboards, and like making whiteboard videos as well. So basically, any application that can be used we may give it a try (Pre-interview, October 2013).

During the implementation of all three learning tasks, teacher participants indicated that they realized that they needed to make more extensive use the following technologies: the
interactive whiteboards and whiteboard videos during the teaching moments; Edmodo to provide continuous assignments and feedback on these assignments; teachers’ blog to blog their learning experiences and progress; Google documents for students/groups to develop their questions, research and storylines for their game concepts and ideas for their storyboards; kidblogs for students/groups to reflect on their experiences and progress throughout and on completion of the learning tasks; videos for student self-assessments; laptops and iMacs to supplement the iPads; and the game software, Scratch. Dave explained that they needed to make greater use of some of these technologies in order to assess the students in this game context:

We’re always looking for new and innovative ways to use technology as a means to getting to the true understanding of where they’re at. I think this unit has had a great influence on bringing technology into it. We wanted to give them as many opportunities and a variety of opportunities to express what it is they know and have fun doing it (Mid-interview, April 2014).

He continued,

we don’t do a lot of blogs; blogs are sort of new for us. We don’t do a lot of journaling, and stuff like that, but this project is a case where technology allows us to play around with their assessments and they are so comfortable with it. If we were to step away from the technology from this point, it might be a little bit more of a hassle than it would be worth (Mid-interview, April 2014).

Matt also stated that

having the blog and being able to read their blogs and see what they’re going through was valuable. We had kids create video discussions on how they feel their video games reflect their own knowledge of the curriculum. By using the video log and by using a blog which takes away the formality of writing, we’re hoping that allows all students full
access to communicating what they know. We believe in using technology to enhance learning, so we don’t want somebody’s maybe lack of writing skills to impede our understanding of where they’re at. I’ve never done that before and I think that’s because we’re using this video game idea (Mid-interview, April 2014).

Although some students indicated that they did not enjoy the blogging experience, they stated that blogging their experiences during each task did help them:

**Boy AB (6.1):** The blog reflections do help me a lot to look back at my errors and what I did great or what I should do right now or for the future.

**Boy CH (6.2):** The blog posts help me a little bit because when you’re writing it, it helps you to reflect back on what you did in that class and then you can notice what you did wrong so you could fix it in the next time, or like what you did right and you can continue doing it next class.

**Girl KE (6.2):** Well I think the blogs were okay because the reflections were great because as you reflect and you find out what you did wrong and then you could find ways to improve it, and you can also look at your group members’ blogs to see how they want you to improve or if you did great, you can kinda keep doing what you doing. [sic]

**Girl LR (6.3):** In the blog, you can write freely. If the classes were not that great, you can say that and you can shoot for better. Personally, when I go back and do reflections, I may not like reflections while doing them, but after I do them, it’s like, yeah, I get it now. The reflections definitely help me to keep my work productive. It’s like what did you do in this class?

**Boy CN (6.4):** I think the blogs/reflections help me to look back to see what I had done. It helps me to relearn what I may forget about the game (Mid-interview, April 2014).

In their use of technologies, the teacher participants indicated that they also encouraged the students/groups to use other technologies to help them in their activities during each task. Some of the students indicated that during the storyboarding and programming tasks, in particular, they made use of the Internet, various apps, such as *Sketch pad* to create backgrounds and characters, pixel app to change pictures into pixels, *iMessages, FaceTime* and *Email* to
collaborate and communicate with programmers (in the library, upstairs), Bamboo, Notebook, Garageband, Tabletop, and glitching apps (Post interview, June 2014).

The teacher participants also stated that their interaction with the technology did pose some challenges to their instruction. For instance, Dave indicated that they experienced some challenges/difficulty using the computer hardware during the programming task. He explained, “this technology has been the most difficult. Making sure that our laptops, iPads and desktops are working has been the most frustrating for sure (Post interview, June 2014).

As the process continued, teacher participants indicated that as they planned their instruction for the programming task, their roles as instructors and facilitators had diminished considerably (as depicted in Figure 16), and by extension, their interaction with the students/groups and curriculum content. Their interaction with each other, the technology and to some extent, the students/groups who were working in the classrooms continued until the end of the programming task.

**More extensive use of coaching and scaffolding.** Teacher participants indicated that in presenting the curriculum content to their students in their social studies classes, they normally designed their instruction to provide guidance and support or coaching and scaffolding to the students in an effort to help them learn and understand the presented content. According to Matt, his “go to strategy” in his teaching sessions involved presenting students with relevant issues and helping them to look at the issue, do some background [research] into the facts surrounding the issue and then taking it to the point where they get to make their own inferences, make up their own mind about the issue, but only after analyzing it from different perspectives (Pre-interview, October 2013).
Dave added that sometimes, they also have to “stand and deliver” to “front load new information” (Pre-interview, October 2013) to their students, when starting new concepts or when the students were really struggling in their understanding of the content being presented.

When asked about the guidance and support provided by their teachers during their social studies classes before the implementation of the intervention, some of the students responded that their teachers would

- teach verbally and visually and give examples a lot of the times . . . tell stories . . . use news articles . . . write it on the board and explain it . . . connect the social studies sometimes to his real life . . . lets us watch videos so we can learn what is going on around the world . . . do like mini projects . . . make us write little assignments on Edmodo (Pre-interview, October 2013).

However, as they implemented the game concept development and storyboarding tasks, the teacher participants stated that they realized that in this context, they needed to provide more extensive guidance and support or coaching and scaffolding. According to Matt, this had been “the most intense part of the process” (Mid-interview, April 2014). He continued,

- I think a lot of our coaching and scaffolding are what we call feedback loops and check-ins and guidance. I think if you are going to take on a unit such as this, and not get involved as the teacher and make sure kids are reporting to you where they’re at, you would be in for some pretty shocking surprises. So we’ve been very active in giving them sort of a road map and then check points (Mid-interview, April 2014).

He further explained that in the implementation of these tasks, providing these coaching and scaffolding activities needed to be done very frequently to encourage a deep learning of the curriculum content as students/groups attempted to communicate a deep understanding of how the citizens in their various models participated in the government decision-making process:
The frequency of that kind of coaching and scaffolding was critical to that context because when you give grade 6 kids the challenge of creating a video game, I have no problem with kids’ imagination. But if it goes wild, and it becomes a month or a two-month long project where they’re not really doing right by the curriculum and those things, then it’s more like busy work instead of rigorous program work. So we had to be very cognizant of that. The learning has got to be happening in step with the game, so the game doesn’t take over (Mid-interview, April 2014).

The teacher participants also indicated that coaching and scaffolding was most needed in the storyboarding task (see Figure 1) because, as Dave explained, they were finding that in the storyboarding, some of the students were really getting overwhelmed without [their] step by step advice and feedback. They didn’t know what to do. So, it was always going back and doing a little re-changing and guiding them, helping them figure out how their game may be, but at the same time, the focus [needed] to be the social studies outcomes (Mid-interview, April 2014).

As teacher participants engaged in the coaching and scaffolding activities, their design tended to reflect the Cates and Bruce’s (2000) Model of Scaffolding, which was initially designed to provide scaffolding to students as they interacted with computers. In their model, activities were categorized into four quadrants spanning from intrusive to nonintrusive (left to right along a horizontal axis) and from prescriptive to nonprescriptive (top to bottom along a vertical axis). Therefore, adapting these quadrants as a framework and drawing upon interview and observation data, I have interpreted and categorized the activities as used by the teacher participants during the coaching and scaffolding sessions (see Figure 2).
In the upper-left quadrant of the model, intrusive/prescriptive guidance and support seemed to be primarily provided through the first teaching moments in all three learning tasks and mainly comprised the purpose, clarification and description of a clear direction for each task and what students/groups were expected to do to meet the goals of each task. For instance, excerpts of the teaching moments by teacher participants that featured that type of guidance and support in each of the tasks can be seen in Table 15.

Table 15

Excerpts of Teaching Moments Depicting Intrusive/Prescriptive Guidance and Support in Learning Tasks

<table>
<thead>
<tr>
<th>Learning Task</th>
<th>Guidance and Support in First Teaching Moment to Begin Task</th>
</tr>
</thead>
<tbody>
<tr>
<td>Game concept</td>
<td>Here’s the first important step of your project, making your decisions about what direction your game will go in. Knowing as much as you can about your chosen topic is crucial to the process. Now, the first thing you’re going to do is choose your topic. You got to choose the icing, the cake but the base was given to you. You have three choices. You could choose one of these three decision-making methods, Consensus, Representative Democracy or Majority &amp; Plurality Voting.</td>
</tr>
</tbody>
</table>

(table continues)
<table>
<thead>
<tr>
<th>Learning Task</th>
<th>Guidance and Support in First Teaching Moment to Begin Task</th>
</tr>
</thead>
<tbody>
<tr>
<td>Game concept development</td>
<td>Then you have three models: Ancient Athens, Iroquois and Municipal &amp; Provincial. No matter what you choose, the major question or problem is “How did/do the citizens participate in the decision making process?” You know the guy that forgot the eggs and he’s making an omelette? Don’t be that guy! Don’t pick a topic right now in your mind and there are no eggs for it. So, I would go scour the pantry right now to see what’s in it. Have I lost you with my metaphor?</td>
</tr>
<tr>
<td>Storyboarding task</td>
<td>You have decided upon a game concept and now you’re going to design that concept. You are going to make that concept come to life. The more work you put into this part, the easier it will be to actually produce what it is you’re trying to produce. So by putting lots of time into this process, it allows you time to think about it, it allows you time to plan it. Everything you do as you create your storyboard, ask yourself the question: Is this communicating our understanding of the government decision-making process? Put your effort where it matters most, that is, in showing us and the people playing the game that you are experts on how decisions were made in your chosen model. That’s why you did all that research you got; it’s time to let that research in. Be realistic! Keep it simple, but keep it smart! Remember, at the end of the day, the game is your way of communicating your deep knowledge of how the decision-making process works in your chosen model. Picture your storyboard as a blue print for your game activity. Anyone who is not in your group should be able to look at your storyboard and understand what it is you are trying to accomplish. Later down the road, once the programmer has taken on his/her role and got some things in Scratch, then we’re going to start getting a little bit more testing of your storyboarding concept. Let’s not be naïve. These storyboards that you’re creating, they are theories. You are saying, in theory this is what my game is going to look like. If any group thinks that their final game is going to look exactly like their storyboards, I got to be there when you realise how wrong you are.</td>
</tr>
<tr>
<td>Programming task</td>
<td>It’s time to get these games ready for building. So, you’re going to now really put on the hat of whatever your role is. The goal is to get things so efficiently done that the programmer programs at school. We’re not interested in seeing what kind of game you can program with 3 hours of work at home. That’s not fair! That that much work would fall on the shoulders of the programmer. So, in the programming, the goal is that it’s done here at school. If time to time you need to do a little bit at home, then that’s fine, but I don’t want kids locked in their rooms with no access to the outside world because they are programming all these wonderful ideas the rest of the group is coming up with including themselves.</td>
</tr>
</tbody>
</table>

(table continues)
In the lower-left quadrant, intrusive/nonprescriptive guidance and support seemed to be primarily provided through follow-up teaching moments at the start of sessions on some days, mostly in the game concept development and storyboarding tasks and mainly to provide feedback on students’/groups’ progress, hints and encouraging reflections on how students/groups could proceed to accomplish the goals of each of these tasks. For instance, excerpts of the teaching moments that featured that type of guidance and support in these tasks can be seen in Table 16.

**Table 16**

*Excerpts of Teaching Moments Depicting Intrusive/Nonprescriptive Guidance and Support in Learning Tasks*

<table>
<thead>
<tr>
<th>Learning Task</th>
<th>Guidance and Support in Follow-up Teaching Moments to Begin Sessions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Programming task</td>
<td>Programmers, you need to meet with your group and it’s very important you communicate to them where you’re at with things. I would have your storyboard out saying, “Got this; I’m working on this; Can’t do this!”, so that you know and the rest of your group knows what’s going into the game. If you just go to the library and the other four are down here and two weeks passes, you might play them the game, show them the game and they there, “What’s this?” So is communication important?</td>
</tr>
</tbody>
</table>

**Game concept development**

You’re going to be in your groups coming up to me pretending that I am the owner of the video game company that you are going to be working for. You’re all very highly paid game designers. You’re highly paid for now. I might fire you or I might give you raises based on how much I like your game. So, groups came up to me and you can see that group 1 got a green light for their game concept, so I gave them a million dollars and we said go get the storyboard done. They went away very happy.

Groups 2 and 3 almost went away happy. I had basically a command: “I said you guys have to go do this after listening to their concepts. I just felt that it wasn’t as strong as it needed to be, so they got a yellow light. So their job is to fix it or make it better or modify it and come back to me for the green light. Group 4 got a red light and I’ll tell you what happened and it might have happened in some of your groups.

(table continues)
Game concept development

Ideas, when you’re collaborating could go in all kinds of crazy directions. Five contributing to one idea can get you pretty much a five-headed monster, sometimes. So their idea missed the mark. It got into an area of Ancient Athens life that had nothing to do with how they made decisions. So I had to say, you guys are too far off track, we’re going to bring you back to reality. So they’ve got a lot to do before they get a green light from me. They basically have to redo their concept. Better now to find out than when? When I’m playing their game. Group 5 got a green light.

Need to pitch that oral conversation with us until you get that green light. Our great concern is that you’re gonna be working hard on your storyboard and then when you have your game, you will actually be looking at the key issue of this activity. Who can tell me what the key issue of this whole process is?

Students respond!

The achievement of this process is to communicate your group’s thorough understanding of the decision-making process used by the people in your chosen models. The conversations between us and you are to get some guidance towards making that game concept work.

Storyboarding task

There is a tendency for some groups to go really complicated with your game ideas. There was one group that had this idea that to start off the game they had to rebuild a piece of pottery. By doing that, that would start the game process. That’s fine and interesting, but not as valuable to the whole activity. Everything you do, you ask yourself the question, ‘Is this communicating our understanding of the government decision-making process?’ You going to need some introduction, but not everything is going to nail it.

What I saw them doing with 80% of their time was working on this puzzle part of their game and then I could see them just packing on at the end of their game, ‘oh yeah, decisions were very hard to make in Ancient Athens’. Don’t unbalance things. Put your effort where it matters most and that’s in showing us and the people playing the game that you are experts on how decisions were made in these models. That’s why you did all the research you got. It’s time to let that research in.

In the upper-right quadrant, nonintrusive/prescriptive guidance and support seemed to be primarily provided through follow-up teaching moments and/or discussions prompted by the students/groups to extend on their thinking and to articulate and reflect on their ideas, while receiving feedback, mostly in the game concept development and storyboarding tasks. For
instance, excerpts of a discussion with feedback that featured that type of guidance and support in these tasks can be seen in Table 17.

Table 17

Excerpts of Teaching Moment and Discussion Depicting Nonintrusive/Prescriptive Guidance and Support in Learning Tasks

<table>
<thead>
<tr>
<th>Learning Task</th>
<th>Guidance and Support in Discussion with Feedback During Sessions</th>
</tr>
</thead>
</table>
| Game concept development | **Teacher:** Basically, you wanted to come here to tell me about your game idea. So, what is our big idea?  
**Student B:** A temple run!  
**Teacher:** Okay, what’s the story?  
**Student B:** So, there is this Iroquois tribe member. He’s going out and he gets into trouble and a couple of warriors or enemies come after him.  
**Student D:** He runs out of the longhouse, out of the village, out of the gate and then he is being chased by three warriors.  
**Teacher:** Okay!  
**Student B:** And then throughout the game there are these different little questions about the Iroquois and how they make decisions.  
**Student F:** And then there’d be two wrong answers and then a right answer and if they guess the right answer right, then they get to go up a level.  
**Teacher:** Okay! Interesting!  
**Student H:** Not so much up a level. I think we need more than just one. So basically the wrong answers are like getting halves.  
**Teacher:** So, here’s my concern: How will someone who does not know anything about the Iroquois play this game successfully? The thing is what you’re creating is a review game, which is good because you’re basically asking a player who knows the Iroquois to go through the game and successfully complete this task. But if your player has no prior knowledge of the Iroquois, they have to guess at every option and that’s probably not the best bet.  
**Student B:** We’re also thinking about putting little hints on the questions, but  
**Teacher:** So, I think you need to figure out how you actually teach it. Is this game actually going to teach your user about decision making in the Iroquois?  
**Student B:** A little bit. |
Teacher: A little bit. It is! But you should maybe think a little bit differently about how you could turn that information, how could you change that same game into something that will not just test their knowledge, but also give the knowledge. You could still do it as like a map-type game but how about instead of being chased by three warriors, you’re like trapped in a cavern. And for you to be able to get out of that cavern, you have to be able to figure out how the Iroquois used consensus. You can find the clues to answer that question within that cavern.

Student B: Suppose we put in clues throughout the different levels?

Teacher: You could potentially! I’m going to let you think a little further on this idea.

Teacher Matt: You want to be authentic within reason.

Teacher Dave: I like that! Yes, they would have perhaps had to vote over the taxes.

Teacher Matt: There is an acceptable level of reality.

Teacher Dave: So basically what they’re doing is taking the essential way it works but they’re not being true to the research.

Teacher Matt: Remember when you said you were doing your research, you wanted to find those golden nuggets. . . There was that point you came across, information to help boost that level of reality that you get a lot.

Teacher Dave: So your question would be, how did ancient Athenians basically find out what was going to be on the Assembly? So you know who decided the Assembly’s agenda, but how was that information posted? Was it a poster? Was it a Cryer?

Teacher Matt: Let’s do a little spot inquiry. Let’s do a little CSI inquiry. How did the word get out? This (pointing to the storyboard) I doubt it was like this and so do you. It’s not like everything in here has to be perfectly identical but if we could see evidence of oh look what they did there, interesting. They worked in their knowledge of the ancient Athenian life that they didn’t need to do. That would be a bonus.

In the lower-right quadrant of the model, nonintrusive/nonprescriptive guidance and support seemed to be primarily provided through instructional conversations, discussions, Socratic dialogues/questions and feedback to provide thought-provoking suggestions, hints and encourage greater clarity, more rigorous thinking and defence of ideas as students/groups aimed
to accomplish the goals of mostly the game concept development and storyboarding tasks. For instance, excerpts of instructional conversations, discussions, Socratic dialogues/questions and feedback that featured that type of guidance and support in these tasks can be seen in Table 18.

Table 18

Excerpts of Discussion, Instructional Conversation and Socratic Dialogues/Questions Depicting Nonintrusive/Nonprescriptive Guidance and Support in Learning Tasks

<table>
<thead>
<tr>
<th>Learning Task</th>
<th>Guidance and Support in Discussion, Instructional Conversations and Socratic Dialogues/Questions During Sessions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Game concept development</strong></td>
<td>Teacher: What do you observe about the difference between the ‘how’ and the ‘what’ questions?</td>
</tr>
<tr>
<td></td>
<td><strong>Student A:</strong> The what questions are googleable, like, ‘What is the council of 500?’ But ‘How did ancient Athens use representative democracy in everyday life?’ isn’t something you can just google. We have to think much more to answer that.</td>
</tr>
<tr>
<td></td>
<td><strong>Teacher:</strong> Do you have an idea of the story you want to tell to bring out how decisions were made by the government in ancient Athens?</td>
</tr>
<tr>
<td></td>
<td><strong>Student B:</strong> I want it sought of to be like we are Spartans and we are trying to infiltrate Greece and convince the army to move out of the way so Greece can attack Athens.</td>
</tr>
<tr>
<td></td>
<td><strong>Teacher:</strong> But we don’t want violence, remember.</td>
</tr>
<tr>
<td></td>
<td><strong>Student B:</strong> It won’t be violence. It will be like trying to move the army out of the area. So it won’t really be violence. But even if it is violence, it will be at the end of the game where no one goes to.</td>
</tr>
<tr>
<td></td>
<td><strong>Teacher:</strong> What decision-making model are you using?</td>
</tr>
<tr>
<td></td>
<td><strong>Student C:</strong> Majority! It’s like you’ll be infiltrating the council of the 500.</td>
</tr>
<tr>
<td><strong>Storyboarding task</strong></td>
<td>Teacher: Alright group 3, what’s your model? Iroquois consensus! What’s the synopsis of the game? What’s the problem? Why are they all here and not over there? Okay, so there’s a land debate, land council, order, everybody scurries to their seats; get introduced to your character. Sounds like a decision tree. You have the lands, the Iroquois leaders, who may stay silent or have a discussion.</td>
</tr>
<tr>
<td></td>
<td><strong>Teacher:</strong> How does this work?</td>
</tr>
</tbody>
</table>

(table continues)
Learning Task | Guidance and Support in Discussion, Instructional Conversations and Socratic Dialogues/Questions During Sessions
---|---
Storyboarding task | **Student:** From here they have two options: They could choose to break the contract, break the confederacy or they can choose to continue to work together and that might go to a happy ending. If most of them keep silent, maybe one of the other Iroquois leaders brings it to the confederation anyway.

**Teacher:** Okay! Did you use the seven generation rule? It’s not even in here. So, did they make a decision that would negatively impact up to seven generations away from now? I think you may need to choose a more specific issue than the land. The land could be destroyed; the land could be sold.

**Student:** Or the land could be taken back by the government?

**Teacher:** So the antagonist in the story is the government or bad guy? And the protagonist or good guys is the Iroquois? So in your game, are you trying to keep your land away from the government or fare-trading the land? The land is an interesting way to go. You could go to the three sister tracks; it could be attributing land space; it could be seven generation rule; it could be encroachment; it could be scarcity of resources, like on the plains the Blackfoot run of the buffalo so they kept having to go further and further instead of going on other people’s land to get the buffalo. It depends on what the issue is, specifically. It sounds like you need to do some more research on the Iroquois. That’s what we want you guys to have. It’s that sort of wide understanding of all these different things. Land as you have it, I think is too vague. So, we are trying to give you an angle. You have to decide which issue you will go with. You could introduce something fictional that sets your choice in motion: there’s a flood, there’s a storm, there’s a tornado, there’s an invasion that creates a land problem, something that forces them to make hard decisions.

Overall, in my observation of the coaching and scaffolding activities in all four quadrants of the model, I observed that the coaching and scaffolding activities in the lower right quadrant, nonintrusive/nonprescriptive guidance and support, seem to dominate the type of guidance and support teacher participants provided during the game concept development and storyboarding tasks, while the activities in the upper left quadrant, intrusive/prescriptive guidance and support seem to represent the type of guidance and support that was least provided throughout these tasks.

**Process/context-dependent assessments and feedback loops.** During our initial planning meetings before the implementation of the learning tasks, the teacher participants
explained that assessments were “one of the big points in [their] practice” and when they decided to adopt the design and building of digital video games as a way for their students to communicate their deep understanding of the curriculum content, they wanted to make sure assessments were embedded in the process. According to Matt,

> It wasn’t simply let’s get seven facts and let’s make a game. Regardless of how the games turn out, we need to be sure that the kids are understanding the concepts around the government decision-making process, which is the curriculum, and we’re trying to develop their creative communication skills in step with building their knowledge of how the government makes decisions (Mid-interview, April 2014).

The teacher participants also indicated that when designing their instruction to teach the social studies curriculum content, they would normally create assessments in advance of the tasks given to their students (Pre-interview, October 2013). However, in this video game design and building context, they stated that they needed to rethink their assessment of student learning as they designed their instruction to implement the game concept development and storyboarding tasks, particularly. According to Matt,

> Normally, we create assessments in advance but because we are dealing with this video game strategy and each group will create something that’s different, we’ve had to really rethink the assessment of it. So that’s changed in that we kind of had to be creative along the way to find out what’s happening, what learning is occurring (Post interview, June 2014).

Dave added that this process provided them with the opportunity to really articulate assessments a little bit more and try to hit those moments like for example, with our peer assessments and self-assessments for group work, that’s a chance.
for them to self assess in things that they don’t usually get to talk about. This was a
different way (Post interview, June 2014).

Matt also explained that in this process, their assessments focused on students’ “abilities
as far as understanding the curriculum and then communicating that understanding in this
creative escape through designing and building the games”. As a result, they had to be “very
mindful of what it is [they were] assessing and how [they were] getting that information” (Post
interview, June 2014).

As the teacher participants implemented the game concept development and
storyboarding tasks, they indicated that they needed to modify their instruction to continuously
make use of various forms of assessments that reflected the context. They deliberately developed
and adapted assessment practices and approaches as the process continued. According to Matt,

> We’ve had to continuously use different forms of assessments because of that context,
and also because of our belief that assessment isn’t something that you do to kids, it’s
something that they’re a part of. Our professional learning goal this year was to really
challenge our methods of assessment. So that worked very well for this project because
this project is quite unique (Post interview, June 2014).

Dave also thought that the various forms of assessments they used had “a lot to do with
the nature of [their] students and recognizing that there are different ways to assess things and to
go with what’s best” and he felt that the more varied assessments would give them a “better or
more complete picture of how a student is doing because otherwise you will be just assessing
using a rubric, or their comfort on camera” (Post interview, June 2014).

These forms of assessments with feedback loops used in designing their instruction at
various points of the implementation of the game concept development and storyboarding tasks
included formative assessments, peer and self-assessments within and across groups, use of
rubrics and a summative assessment, with teacher and/or students’/groups’ feedback loops to assess students’ progress and achievement (see Figure 23). According to Dave, “all these assessments allow[ed] them to make a better change towards improvement” (Post interview, June 2014).

*Figure 23.* Forms of assessments and feedback loops used in the teacher participants’ design of instruction during implementation of learning tasks

**Formative assessments.** The teacher participants indicated that as they implemented the game concept development and storyboarding tasks, they needed to make much more use of formative assessments—continuous assignments in Edmodo, frequent instructional conversations, discussions and/or Socratic dialogues/questioning between teacher participants and student group members, which also involved a great amount of coaching and scaffolding with teacher feedback, and students’/groups’ reflections in their Kidblogs. Matt explained, “We’re doing way more formative assessments. The difference is in more structuring those formative assessments and trying to figure out where they can begin for feedback on the game concepts and the storyboards” (Mid-interview, April 2014). Dave further explained that these assessments, which he referred to as “check-ins” greatly informed the next steps in the process:
The big thing with all that formative stuff is ensuring or trying to make sure that those steps are being taken. So if we do those check-ins or whatever it is that they’re going to be doing, we can look at them and decide our next steps. For example, when they set up their concept content and in the concept they say here is our main questions, we can look at that and see that most of the groups have figured this out. But some groups are still talking about content that has nothing to do with decision making. And if we didn’t have that check-in, they could have spent a month building a game that has nothing to do with the decision-making process or their topics, in which the value would be in the game creation. But in terms of our understanding, we need to see how game creation can be useful in learning and understanding the content (Mid-interview, April 2014).

**Self-assessments.** The teacher participants tended to promote self-assessments with feedback loops through a rubric, *Let’s Reflect* (see Chapter 4 and Appendix L), reflections in the kidblogs and video discussions/video logs or what they termed elevator pitches. They stated that they used the *Let’s Reflect* rubric and reflections in the kidblogs to assess how individual students cooperated, contributed, communicated and collaborated, as well as to address the conflicts that were evident within their groups (as described in Chapter 4). According to Matt, “in this modern unit, the collaboration is something that we’ve constructively aimed to assess through self-assessments and peer reflections to know how well they’re doing with that collaboration aspect” (Mid-interview, April 2014).

The teacher participants also stated that they allowed individual students to create one-minute video discussions/video logs or elevator pitches to assess the strengths and weaknesses of the design and content of their storyboards, (as described in Chapter 4; see samples in Appendix S). Dave explained that using these video discussions/video logs was “a really great way to reflect on the areas that [students] were working on because it can be more open ended and our
point was to assess the self-assessments, and a video is a great check in” (Mid-interview, April 2014). Matt further explained that he had never used this method to assess students before this process and thought that “By having kids use the video log, it opens up more opportunity for those that may be aren’t the strongest in communicating. So that’s really the theory behind that” (Mid-interview, April 2014). He continued,

We don’t want it just to be a unit where kids make a video game. We want them to make a video game to communicate their understanding. So we have to be clear on what their understanding is regardless of how the video game turns out. These feedbacks, I think, they’re providing us with, is basically the information about how well the students are doing (Mid-interview, April 2014).

**Peer assessments.** The teacher participants tended to mainly promote peer assessments with feedback loops within and across groups (student-student, student-group, group-student, group-group). They explained that the group-group assessments or what they termed ‘group-share reflections’ were used to allow groups to assess and provide each other with feedback on the strengths, weaknesses and suggestions for improvement of the design and content of their storyboards, where needed (as described in Chapter 4). Within groups, the teacher participants also explained that they used the *Let’s Reflect* rubric to allow peers (student-student, student-group, group-student) to assess and provide feedback on their skills in cooperating, contributing, communicating and collaborating as they attempted to address the conflicts that were inhibiting groups’ progress in accomplishing the learning and intervention goals within the game concept development task (as described in Chapter 4).

Dave explained that they also needed to carry out this type of peer assessment because they realised that they needed to “model more and teach more about conflict resolution and how groups can work together more constructively. Instead of just saying you just need to work
better, we had to figure out what the problem was in there and try to move forward” (Mid-interview, April 2014). He further explained that

without that assessment, we’d just be beating our heads against the wall because kids can understand what they’re getting or they’re being difficult about the people they work with. But I think if you had every group member say like “we need you to do this for us” then we could really help them and we understand that this may be tough for kids but we also expect that they can handle it in mature ways. So we use that information and realise it’s not about being punished, it’s not about they’re in trouble, but we’re trying to use it for them to move forward and become more effective as collaboration is one of our most important skills (Mid-interview, April 2014).

**Summative assessment.** Summative assessment was used to assess individual students’ contributions through their roles to the successful continuation, completion and meeting the learning goals of all the tasks (as described in Chapter 4; examples of students’ responses in this assessment can be seen in Appendix T). Matt explained that this summative assessment was not about their video game execution skills. It was about their ability to take research and create a story out of it. So that was our knowledge. We came up with those 4 components—self reflection was the big one, collaborative skills were a big one, and then at the end, we wanted them to be accountable for the role they were assigned and how well did they execute the role that they were given. So, those 4 things create a pretty strong picture of how well they performed in this process. It really helped us focus our assessment (Post interview, June 2014).

**Rubrics.** The teacher participants explained that the design or construction of the rubric they used to assess group performance was a collaborative effort between themselves. However, the design or construction of the rubric to assess summative performance was a collaborative
effort between themselves and their students, guided by questions (as seen in Chapter 4), that would allow the “kids [to] strongly reflect on how their assigned role was and what they feel [was] strong in their game because of them and what things they feel could have been better” (Post interview, June 2014). Dave explained that the rubric was a better choice for them to use when assessing the groups’ and overall individual performance because “it allow[ed] them to use it as a checklist” (Post interview, June 2014), which helped to inform them as to what needed improvement and students’ overall progress and performance in the learning tasks.

Conversational thinking. During the implementation of the game concept development and storyboarding tasks, Matt indicated that they needed to “encourage conceptual thinking to a greater degree” (Post interview, June 2014) than they would normally do in their instruction because of the nature of the tasks. More specifically, as they coached and supported student learning and understanding of the curriculum content, there seemed to be an increased need to encourage students/groups to inform their ideas/concepts and skills with the research carried out, identify important/significant information that would help to refine their game concepts and storyboards, apply their previously acquired knowledge about the content, think of creative ways to solve the given problem, and assist them in relating their game concepts to creating/designing broader concepts through their storyboards. According to Matt, encouraging that type of thinking to a greater extent was

to make sure that [students/groups] were on the right track towards demonstrating their deep understanding of the decision-making process in whatever chosen topic they were going for and not getting distracted by the game and the fun of it. I had to really make sure that they had extended their concepts to a point that does honor the curriculum that we are trying to deliver. There also has to be that social studies tie-in. Keeping them on track that way was a big challenge, though (Mid-interview, April 2014).
Dave also explained that he thought that they needed to encourage that conceptual thinking because

normally, if the students have ideas of what they’re going to do, we can look at the samples of work and say this could potentially look like this. But because this hasn’t happened before, and this project is new, we don’t have those samples and so, we’re really encouraging that degree of conceptual thinking to also find out what their ideas could potentially look like. I’ve had to do more of that now than I’ve actually done in the past just because I think we don’t know what the end product will be and the ideas that they’re giving us require some shaping to be as effective as they need to be (Mid-interview, April 2014).

**Divergent thinking.** The teacher participants also stated that during the implementation of mostly the game concept development and storyboarding tasks, they also needed to encourage divergent thinking to a greater degree than they would normally do when teaching social studies. More specifically, as they coached and supported students'/groups’ deeper learning of the curriculum content, there seemed to be an increased need to encourage students/groups to challenge the game concepts and storyboards through deeper thinking, research and assessments, and present, critique and accept various interpretations of the game concepts and storyboards from their teachers and peers.

According to Matt, “This strategy encapsulates a lot more divergent thinking” (Mid-interview, April 2014). Dave added that although they typically use divergent thinking in their instruction, in this case, they needed to encourage this type of thinking to a greater degree because

the end product is much more ambiguous and so open-ended and that there’s so much choice there that they need to be able to hear from other voices than just their teacher.
So allowing them to get that peer feedback in order to go and extend beyond what each group is telling each group, we had to do that (Mid-interview, April 2014).

**Increased theoretical support for design of learning tasks’ activities.** In addition to situated learning theory, which informed the theoretical framework for the design and implementation of the learning tasks, there seemed to be evidence of other underlying learning theories supporting the teacher participants’ design and implementation of the tasks’ activities—e.g., constructionist and connectivist ideas to complement constructivist ideas that they indicated were mainly used to inform the initial design of the tasks’ activities. During the post interview, I brought this observation to the attention of the teacher participants, who seemed interested in probing further to understand the actual theoretical support for their design of the tasks’ activities. The teacher participants confirmed that one of the design principles that guided the design of the learning tasks’ activities was the use of constructivist-based learning. According to Dave,

> We used a constructivist-based method and that’s what we do. It starts kind of fairly guided and then becomes really hands-off along the way, and then challenging when they have to figure things out as they go and to kind of construct their own understanding based on information they learn from us and information they learn from their peers (Mid-interview, April 2014).

Matt further explained that in using constructivist ideas to support the learning tasks’ activities, they wanted their students “to be thinkers and this challenge required thinking and it required creativity and collaboration just to get the game finished. It mirror[ed] what probably happens in real life jobs” (Post interview, June 2014).

However, the teacher participants indicated that as they guided and supported their students/groups to creatively develop, construct or design and build their artifacts (mostly game concepts and storyboards) within that constructivist-informed pedagogy, they still needed to
“think on their feet and adapt a little bit” (Post interview, June 2014) to keep the tasks clearly aligned with the learning and intervention goals. The teacher participants explained that they had to greatly encourage students/groups to collaboratively construct their knowledge and understanding of how the citizens in their various models participated in the government decision-making process through inquiry/learning, more discussions/Socratic dialogues/questioning, brainstorming and making/developing their ideas through research, imagination, invention, and personal reflection in the game concept and storyboarding tasks.

Then they had to encourage students to effectively use the results of these ideas to construct personally meaningful products or their own video games “regardless of how the games turn[ed] out” (Matt, Mid-interview, April 2014) over an extended period of time in the programming task. According to Matt, “I didn’t want the experience to be learn some facts, and create some form of quiz game. I wanted them to sort of really take on what they’ve learned and then take it one step further and create something new” (Post interview, June 2014). I pointed out that these activities involving students/groups brainstorming their ideas through research, imagination, invention, and personal reflection to construct their game artifacts, were also typical of constructionist ideas and that they were also using a constructionist-informed pedagogy along with their constructivist-informed pedagogy.

The teacher participants also explained that as they implemented the tasks’ activities, they also needed to greatly ensure that link/connection of students/groups to their peers and as many resources as possible (Edmodo, computer hardware, game software/Scratch, SMART board, videos, blogs, apps, and so on). This was to allow for that deeper collaboration, communication, support and sharing of their learning and understanding of how the citizens in their various models participated in the government decision-making process, as well as providing the opportunities for their intellectual engagement and development and use of 21st century
competencies during this learning experience. Linking/connecting students to groups through specific roles and groups to groups were, according to Matt, necessary to keep students moving forward during the process. They both indicated that the students needed to “work as an effective group” using more “authentic collaboration”, so as a result a “real emphasis was the collaborative aspect of it all” (Dave and Matt, Mid-interview, April 2014).

Dave further explained that linking/connecting students/groups to the various technologies, for instance, was also necessary to “give them as many opportunities and a variety of opportunities to express what it is they know” (Mid-interview, April 2014). These activities, I pointed out, were also typical of connectivist ideas or connectivism, described by Downes (2007) as “the thesis that knowledge is distributed across a network of connections, and . . . that learning consists of the ability to construct and traverse those networks” (para. 1) and that they were also using or incorporating connectivism into their instructional design of the learning activities along with constructivist and constructionist learning theories.

In short, the findings on the identified shifts in the teacher participants’ design of instructional activities with some emerging design principles to guide the design of the learning tasks’ activities, presented in this section, seemed to contribute to the overall impact of the design and building of digital video games, through the learning tasks, on students’ deep learning of the curriculum content as they attempted to communicate a deep understanding of how the citizens in their various models participated in the government decision-making process, their intellectual engagement and development of 21st century competencies. An analysis of that impact is presented in the following sections.
Impact of the Design and Building of Digital Video Games on Students’ Deep Learning

In this design-based research study, the impact of the design and building of digital video games on students’ deep learning was analyzed based on the following deep learning themes: knowledge creation, disciplined inquiry, critical thinking skills, higher order thinking skills, teacher-student interaction and understanding, student-student collaborative discourse, communication, active learning, formative assessment, self assessment/peer assessment and feedback. These themes are described in the Classroom Observation Protocol for Student Deep Learning of Content (see Appendix F), and were used to guide researcher observation of students’ deep learning as they participated in the learning tasks’ activities.

Figure 24. Radar graph showing evidence of student deep learning in the game concept development, storyboarding and programming tasks
Based on researcher observation, deep learning themes seemed evident in all the learning tasks, but overall, they seemed to be most evident in the storyboarding task (see Figure 24).

More specifically, in the game concept development task, the data seemed to indicate (also see Figure 25), that throughout the task, knowledge creation seemed evident in 12 of the 14 sessions and was supported by disciplined inquiry, critical thinking skills, higher order thinking skills, teacher-student interaction and understanding, active learning, formative assessment and feedback in 10 of the 14 sessions. Student-student collaborative discourse, communication and some self and peer assessment seemed evident in 6 of the 14 sessions as students/groups developed their game concepts.

![Bar chart showing evidence of student deep learning in the game concept development task according to sessions](image)

*Figure 25. Bar chart showing evidence of student deep learning in the game concept development task according to sessions*

In the storyboarding task, the data seemed to indicate (also see Figure 26), that throughout the task, knowledge creation strongly supported by disciplined inquiry, critical thinking skills, higher order thinking skills, teacher-student interaction and understanding, student-student collaborative discourse, communication, active learning and feedback seemed most evident in all
18 sessions. Some formative assessment seemed evident in 12 of the 18 sessions, while self and peer assessment seemed evident in 8 of the 18 sessions as students/groups created and designed their storyboards based on their game concepts.

![Student Deep Learning in Storyboarding Task (n=18)](image)

*Figure 26.* Bar chart showing evidence of student deep learning in the storyboarding task according to sessions

In the programming task, the data seemed to indicate (also see Figure 27), that throughout the task, critical thinking skills, higher order thinking skills, self and peer assessment and feedback seemed most evident in all 42 sessions and strongly supported by disciplined inquiry, student-student collaborative discourse, communication and active learning, which seemed evident in 34 of the 42 sessions. Knowledge creation and teacher-student interaction and understanding seemed evident in 22 of the 42 sessions. These two themes seemed more evident in the game concept and storyboarding tasks. The formative assessment that seemed evident in 10 of the 42 sessions was provided by the teacher participants to the other group members in the classroom as they prepared the information needed by their programmers to build the games.
To probe further into these findings, I used the mid- and post interviews with teacher participants and groups of six students (at least one member from each group) from each grade 6 class, and excerpts from all the students’ Kidblogs and Google documents, teachers’ blog, transcribed instructional conversations, discussions and/or Socratic dialogues/questioning between teacher participants and student group members, teacher feedback, students’ self and peer assessments and examples of students’ game artifacts (game concepts, storyboards and prototypes). This helped to substantiate my observations and to provide possible evidence of the ways in which students’/groups’ design and building of their video games seemed to impact their deep learning of (i) the curriculum content, demonstrated in students’/groups’ communication of their deep understanding of how the citizens in their various models participated in the government decision-making process; and (ii) other possible content, such as role-specific skills, technologies, game aspects or game design principles and the game software/Scratch.
According to their overall mid- and post interview responses, teacher participants seemed to indicate that students’/groups’ participation in the learning tasks’ activities did encourage a deeper learning of the curriculum content as they attempted to communicate a deep understanding of how the citizens in their various models participated in the government decision-making process, more so, in the game concept and storyboarding tasks. According to Matt, “They’ve chosen one model and they’ve spent many months working on a game concept and turning it into a video game. We have them focused not on the trivial details but the true meaning of how the decisions were made in that context” (Mid-interview, April 2014). As a result, according to Dave, “throughout the activities, they’ve been showing their understanding kind a every step of the way and so you see that deep learning as they go” (Mid-interview, April 2014).

Matt further stated that because students/groups had been interacting with that curriculum content so much, he thought that there was evidence of deep understanding of that content. As he encouraged that deep understanding, he explained that his reflections throughout the activities included “how can I ensure that there is a sufficient enough amount of information. However much information they’ve used in the game, the better, because what they do bring into the game, they do meaningfully connect with (Mid-interview, April 2014). He further stated that they did put a lot of work into the [students/groups] and then the students’/groups’ job was to put it into Scratch. Even if the Scratch game is average, or doesn’t quite work, we can go back and say we know the kids got a lot of learning out of this because here it is. As far as making a video game, that’s a great way to learn the curriculum if it’s done right. If there’s a story behind it, it’s a nice way to communicate what they know (Mid-interview, April 2014).
Based on their responses in the mid- and post interviews, most of the students/groups seemed to support their teachers’ views that their participation in the learning tasks’ activities did lead to a deep understanding of how the citizens in their various models participated in the government decision-making process, more so, in the game concept and storyboarding tasks. Their various opinions on why they thought so are captured in the following examples of their responses, across classes:

**Girl NF (6.1):** We always have to go back and do just a little more research when we are unsure and we don’t want our game to be like untrue so we have to keep going back to make sure.

**Boy BL (6.2):** We definitely had to know how they made decisions to be able to create the right game because if you didn’t know the right information, you would be teaching other people false information.

**Girl LR (6.3):** I think so because we had to know almost everything about our topic, whether it’s the Iroquois, Athens or modern day so we can understand it clearly to actually make the player understand as well.

**Boy CV (6.4):** I think we’re learning more because normally with school, you learn it, you keep the information in your head for a test and then you let it go. That’s what happens in schools. But in this project, we have to learn it, keep it or remember it and then use it in Scratch. So it’s actually like having to remember it, and not just remembering it for a test, go on to another unit, come back and then do it again (Mid-interview, April 2014)

**Boy LT (6.1):** You have to do something that actually really makes you learn and I think this was a good way to get to do that. It really encouraged us to try to get involved in like thinking about the way that they thought in Ancient Athens or the Iroquois or kind a into that world. And like getting to make a game was definitely a way to get me kind of passionate about doing something like that.

**Girl PC (6.2):** I thought that this project helped us to kind of learn about our topic at a deeper level because we had to put ourselves in the place of someone who was in the Iroquois confederacy or in Ancient Athens, so it did help us learn deeper.
Boy CU (6.4): It’s a better way to learn and I think it sticks the information in my head and I think that if we didn’t create a game, I probably wouldn’t have a better understanding of it (Post interview, June 2014).

To probe further into teacher participants’ and students’/groups’ claims, across classes, that the learning tasks’ activities encouraged a deep learning of the curriculum content, possible evidence was sought by the researcher to support or refute their claims. A further analysis of some of the activities and outcomes of each task was, therefore, carried out.

**Deep Learning in the Game Concept Development Task**

In the game concept development task, students’/groups’ engaged in the creation of game concepts to inform the building of their video game prototypes in an effort to communicate their deep understanding of how the citizens in their various models participated in the government decision-making process (as described in Chapter 4). In the post interview, about 71% of the students indicated or claimed that as they developed their game concepts, they believed that they were learning and understanding how the citizens in their various models participated in the government decision-making process at a deeper level. The following responses from some of these students help to capture reasons for this claim:

**Boy OD (6.1):** I think when we had to come up with our guiding questions and the game concept we had to learn a deeper amount of information than if we had to do it for a presentation. That helped with the storyboard because the storyboard didn’t help us deepen our understanding of the confederacy or democracy.

**Boy RA (6.2):** I think we learned deeper when we were developing the game concept because we had to make deep questions and get like the big things answered.

**Boy JL (6.2):** We worked our brains to put down all we know, so we could come up with our game idea, so we could storyboard it.

**Girl PC (6.2):** I think that development of the game concept helps me learn and understand the most because we had five guiding questions that would help us research more.
Girl YS (6.3): Well, at the beginning, we did a lot of research and that was really cool. We did a lot of debate like if we were going to do this in our game and it really helped our understanding of Ancient Athens.

Boy JA (6.3): It combined social studies and making our game because you have to come up with a story, but you also have to research to find out information before you make the game and then it also involves thinking skills because you have to find out how to implement the research into your concept.

Boy UR (6.4): We had to research to a deeper level because we needed to fully understand the process to put it in our game. So I think we were going with quality, not quantity.

Boy TM (6.4): It’s just the fact that we have to keep going over the facts and if the facts are wrong, the entire game falls apart. So we were kind of required to go at a deeper level for our game to work (Post interviews, June 2014).

However, about 29% indicated that they had already learned a lot about their chosen model through previous research and did not think that they were learning any new information. This is reflected in the following responses:

Girl OR (6.3): I don’t really think we actually learned about the decision-making process from working on our game concepts because we were just applying our knowledge about decision making into the game.

Boy MW (6.3): Most of the information that’s in our research, it’s all been from the projects we’ve done before. So we haven’t had to go back and do any research because we’d already know everything about the decision-making process.

Girl MG (6.3): When I was working through the game concept, I didn’t really learn much more. It just reminded me about the information that I already learned.

Girl CW (6.4): Our group chose the Iroquois consensus because we had already learned about the Iroquois and consensus and the decision-making process. So it was kind of like we were just building off of that and it was a little bit easier to do because we already knew a lot about it and we did not have to do much research.

Girl OW (6.4): It wasn’t like we were learning anything new. We were just taking what we already knew and putting it into our game concept. All we were really doing is taking what we know and putting in into
something else because nobody wants to do more research because it’s not really something they’re really passionate about.

Boy CU (6.4): Well, I already knew a lot about it. Like before we started the Scratch we were doing a lot of the Iroquois and a lot of the Ancient Athens. So I already had a whole bunch of information. In my group, we didn’t really have to do any more research because we had so much information already (Post Interview, June 2014).

A further analysis of some of the outcomes of this task’s activities helped to provide possible evidence that support or refute teacher participants’ and students’/groups’ claims for deep learning of the chosen curriculum content as students/groups attempted to communicate their deep understanding of how the citizens in their various models participated in the government decision-making process.

**Possible evidence of deep learning of the chosen curriculum content in the game concept development task.** To promote a deep learning of the curriculum content in the game concept development task, the teacher participants indicated that they mainly used formative assessments (continuous assignments in Edmodo, frequent instructional conversations, discussions and/or Socratic dialogues/questioning between themselves and student group members, which also involved a great amount of coaching and scaffolding with teacher feedback and students’/groups’ reflections in their Kidblogs). Matt explained that using formative assessment as an instructional approach to encourage or promote that deep learning of this curriculum content in the game concept development task was like “gathering of the information, but then, like sifting through the information to find what’s most important and that was definitely where most of [his] energy was spent” (Mid-interview, April 2014).

For instance, the following excerpt, from one of the discussion sessions between Matt and five of the groups on developing effective questions to guide the research that would inform their game concepts appears to capture how he helped students/groups to demonstrate their
understanding of the problematic nature of their questions, while allowing opportunities for deep learning:

**Teacher:** So K you’re doing representative democracy in Ancient Athens?

**Student K:** Yeah! Our questions are:
- Who are the citizens of Ancient Athens?
- Where did they come to a decision?
- What is the Council of 500?
- What is the Assembly?
- How did the citizens come to a decision?
- Who were the VIPs of Athenian democracy?

**Teacher:** Okay! K’s group is trying to become extensively knowledgeable about how majority rule worked in Ancient Athens. Are those questions going to provide them with a deep understanding? Are they googleable?

**Student A:** The what questions are googleable. Like “What is the council of 500?” But “How did the citizens come to a decision?” isn’t something you can just google. We have to think much more to answer that.

**Teacher:** When you’re talking about a guiding question it’s not a good thing when it’s easily googleable. Developing guiding questions is tough stuff. This is where grade 6 starts to become really challenging. So, ‘What is the Assembly?’ Let’s take a look at that question. If you are off to find information about the Assembly, you need a deep understanding. What is the Assembly? Answer it for me.

**Researcher (observing):** About 95% of students raised their hands to answer the question.

**Teacher:** That many hands up tell you that it’s not that complicated. It’s not that deep. What’s the answer?

**Student H:** It’s a forum where people meet to vote on issues.

**Teacher:** It’s not deep enough! So how do you take that question and dig a little deeper into it?

**Student H:** Well maybe can we compare it to how they do things or decisions today?

**Teacher:** Okay, so we look at a comparison? Interesting! Any other suggestions?
Researcher (observing): No answers forthcoming from students.

Teacher: ‘What is the Assembly?’ I could look at the first word: ‘What’ and change it to a different question word.

Student M: How did the Assembly work?

Teacher: I think that is better. I think you could go even deeper. But I would definitely look at your questions and ask, ‘Are they easy to answer?’ That to me looks like a little quiz I can give to my grade 6s, where I say ‘What is the Assembly’ and I then I check a bunch of underscores and leave a line there. Could you fill that in a quiz?

Students (all): Yeah!

Teacher: Not deep enough then! K, I’m going to let your group keep working on this. I’m going to get you to submit those guiding questions the way they are for our feedback. . . (Game concept development task, Session 5, March 2014)

Deep learning seemed evident as student’/groups’ engaged in, for example: disciplined inquiry by demonstrating an understanding of the problematic nature of the ideas on the questions with their teacher; critical thinking by critically assessing their ideas on effective questions and reflecting on different points of view; teacher-student interaction and understanding by actively constructing their learning and building new knowledge on effective questions in partnership with their teacher; and communication by demonstrating their ability to listen to their teacher and peers with purpose (Appendix F).

Examples of students’/groups’ game concept artifacts created in their Google documents (see Table 19) also seemed to represent students’/groups’ collaboratively constructed domain knowledge for their games in their chosen models (Ancient Athens, Iroquois Confederacy and Municipal and Provincial [current era or modern day]). Creating these artifacts seem to demonstrate students’/groups’ deep learning as they engaged in, for example: knowledge creation by collaboratively contributing and integrating new ideas into the research on their various models; critical thinking by brainstorming and reflecting on different points of view from their
teachers and peers to develop new ideas for their game concepts; higher order thinking by manipulating the research and their new ideas and transforming them into authentic game concepts; and active learning by designing their learning through processes of co-construction and interacting and communicating with each other and their teachers through formative assessments and feedback and showing a sense of ownership of the material (Appendix F).

Table 19

*Examples of Game Concept Artifacts Created by Students/Groups in Google Documents*

<table>
<thead>
<tr>
<th>Title</th>
<th>Decision-making Methods</th>
<th>Decision-making Models</th>
<th>Game Concepts</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>The Clan Mother</em></td>
<td>Representative Democracy</td>
<td>Iroquois</td>
<td>The player starts as a clan mother who is trying to find a chief. The clan mother will start in Oneida and run through the Oneida nation and Mohawk nation. The clan mother will arrive in the Onondaga at the longhouse.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>On the way to the longhouse there will be many obstacles like trees, rivers and rocks. The Clan Mother talks to citizens about their problems. Then she will ask the 4 Chiefs about the issues and what they would do to resolve those issues. After listening to the Chiefs solutions the Clan Mother will pick the Chief they want to lead their Clan.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Our game starts like this. You get to choose your clan mother once you have your clan mother it list’s characteristics that the chief should have. After you look at the all characteristics it will list all the chiefs and above theme it will show all the characteristics that the chief has. But some of the codes will be missing some of the most important characteristics. If you pick one that has the right characteristics your game will go the right way. On the other hand, if you pick one for instance if one can not withstand criticism and that is not kind hearted your game will go the wrong way. If it goes the wrong way you try to use consensus to solve it.</td>
</tr>
</tbody>
</table>

(table continues)
The player has to take role of the clan mother and the player has to choose a chief. When you are choosing the chief you have to read the status of them. This is what your looking for, honesty kindheartnes and is able to withstand criticism. And think to what is best for the people now and or in the future. You also have to search for one on the grass before you go into the decision making house.

The player has to resolve an issue between the Europeans and the 5 clans. That issue is going to be wheather they should share the languages, and the techniques of building hunting and culture between them.

There is a big issue on weather the 5 nations should stop trading with the white people. You have to give the chief advice in a little box in the centre on what to do in this circumstance.

When you meet a villager in the game they tell you their name and a little bit of their life. They tell you what they do as for making a living and sometimes give you an update on what’s happening in the town and what’s presumably going to happen in the future if your lucky.

You get dropped off with three paves ahead of you and a whole bunch of villagres and chiefs walking around on the grass, you find yourself choosing a path one of three. when go through that path you see a house on the other side with even more people on the grass you face a problem for each path you choose. there is no end for the game. the more problems you solve the more people add on to the next problem so its harder for consensus work.

<table>
<thead>
<tr>
<th>Title</th>
<th>Decision-making Methods</th>
<th>Decision-making Models</th>
<th>Game Concepts</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Journey To The Onondaga Clan</em></td>
<td>Consensus</td>
<td>Iroquois</td>
<td>The player has to take role of the clan mother and the player has to choose a chief. When you are choosing the chief you have to read the status of them. This is what your looking for, honesty kindheartnes and is able to withstand criticism. And think to what is best for the people now and or in the future. You also have to search for one on the grass before you go into the decision making house. The player has to resolve an issue between the Europeans and the 5 clans. That issue is going to be wheather they should share the languages, and the techniques of building hunting and culture between them. There is a big issue on weather the 5 nations should stop trading with the white people. You have to give the chief advice in a little box in the centre on what to do in this circumstance. When you meet a villager in the game they tell you their name and a little bit of their life. They tell you what they do as for making a living and sometimes give you an update on what’s happening in the town and what’s presumably going to happen in the future if your lucky. You get dropped off with three paves ahead of you and a whole bunch of villagres and chiefs walking around on the grass, you find yourself choosing a path one of three. when go through that path you see a house on the other side with even more people on the grass you face a problem for each path you choose. there is no end for the game. the more problems you solve the more people add on to the next problem so its harder for consensus work.</td>
</tr>
</tbody>
</table>

(table continues)
<table>
<thead>
<tr>
<th>Title</th>
<th>Decision-making Methods</th>
<th>Decision-making Models</th>
<th>Game Concepts</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Lost with Clues</em></td>
<td>Majority &amp; Plurality Voting</td>
<td>Ancient Athens</td>
<td>A metic boy, aged 15, named Cyrus Sapphonian went on a hike one day and went to the mountain Parnes. While he was on his hike he heard a sound like a dying donkey, and went over to investigate. When he got to the sound he found a griffin, when he looked closer he saw that the griffin had tear in his wing. Cyrus takes the griffin and starts to walk to his camp by the river. When he gets there he makes sure to hide the griffin, and cares for it later that year nikons wing is cured and Cyrus figures out that Nikon is 6. Eight years later Cyrus is 23 and Nikon is 14. Cyrus keeps on caring for Nikon and they are best friends. But Cyrus isn’t allowed to have a pet because he is a metic. He sneaks out to go see his griffin (Nikon) because he’s a rebel and he gets caught by some guards. He really loves Nikon and feels lonely without him because he has no family. The guards send his griffin away and he gets really angry and sad. Eventually he is to lonely without Nikon. He decides to do something about it and begins to adventure through Athens. He travels around Athens and gets 5 clues along the way about democracy and has to go where the clues direct him. The main goal is to get to Hymettus Mountain. At each clue it directs somewhere in Athens. When he gets to the mountain he puts all the clues in the door of the cave and then the cave opens and he saves the mythical creature.</td>
</tr>
<tr>
<td><em>Athens Adventure</em></td>
<td>Majority &amp; Plurality Voting</td>
<td>Ancient Athens</td>
<td>Our character is a metic that turns into a citizen. He is trying to solve if he is a citizen or a metic through a bunch of mini tasks. You have to tell the man about info on how citizens participate in government and he will tell you if he is a metic or citizen. He will be operating through the city-state of ancient Athens. In our game you will have to go through a bunch of mini games to get the answer you seek.</td>
</tr>
</tbody>
</table>

(table continues)
<table>
<thead>
<tr>
<th>Title</th>
<th>Decision-making Methods</th>
<th>Decision-making Models</th>
<th>Game Concepts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ancient Athens Scratch Project</td>
<td>Representative Democracy</td>
<td>Ancient Athens</td>
<td>Spartans attack the Athens but before they capture all of the citizens a young boy escapes out into the woods. After a long search for the boy the Spartans give up and go home. The boy walks for a long time then he comes up to a Athenian temple deep in the woods. He enters the temple and is approached by a god the god tells him the only way to get to Sparta is to search through the anheint Athenian temple there you will find 5 maze challenges that will prepare you for a battle that can save your democracy. Once completed you will study the ancient book of battle then you shall save your family now go take this grape fruit it will be your only source of food, Good Luck!</td>
</tr>
<tr>
<td>City of Calgary Municipal Voting System</td>
<td>Majority &amp; Plurality Voting</td>
<td>Municipal &amp; Provincial</td>
<td>A judge, living in a condo, decides his job is boring, he then runs for mayor. He has to do a job interview, where the character picks the statisticstics of their profile. He has to talk to people with different interests and choose what to talk about. You need to choose what kind of advertisement you want. He can attend the voting and show the player the voting. Also checking the news paper could be a mission which would talk about the party that is currently leading. The radio could talk about different complaints the people have talked to the council about. He could go to people and tell them how they can vote. The game could promote being a good citizen and doing your part for the community. He could look at different government facilities and see if they need improvement.</td>
</tr>
</tbody>
</table>

Deep Learning in the Storyboarding Task

In the storyboarding task, students/groups organized their game concepts into a sequence of elements that would function as a road map to the actual building of their video games, in an effort to communicate their deep understanding of how the citizens in their various models participated in the government decision-making process (as described in Chapter 4). In the mid-
and post interviews and blogs, teacher participants and all of the students claimed that in engaging in the creation or designing of the storyboards, there seemed to be strong evidence of deep learning of the curriculum content, demonstrated in students’/groups’ deep understanding of how the citizens in their various models participated in the government decision-making process, as well as other content including their role-specific skills, technologies and game design principles. According to Dave,

we saw the deepest learning of the curriculum when [students/groups] were creating their storyboards to show what they knew and then having to articulate their storyboards in their pitches and group share. Storyboarding helped them figure out exactly what it was they were going to be doing and helped them fill in the blanks a little bit for the learning they had done on some content knowledge before. But what the storyboarding really helped them articulate from this is going from knowledge I have, to how do I communicate this to everyone (Post interview, June 2014).

Based on their responses in the post interviews, all of the students (100%) seemed to support their teachers’ views that, as they participated in the storyboarding task’s activities, they were demonstrating a deep understanding of how the citizens in their various models participated in the government decision-making process. The students’ various opinions on why they thought so are captured in the following examples of their responses, across classes:

**Girl EC (6.1):** At one point in our storyboard, we had to use a longhouse so we had to research what a longhouse would look like and all the facts about the longhouse that you really would not have paid attention to if you are just doing a research project. We had to do deeper research because since it’s a game we had to know the content very well.

**Boy WP (6.1):** I think the best deeper steps about the decision-making process was learnt during the storyboard rather than in the game concept because in the storyboard you had to draw and describe what everything looks like and those nitty-gritty details that you won’t really care about using a presentation.
Boy UM (6.2): I think our group probably learned the most about the Ancient Athens through our storyboarding because when you have the information and you have your game idea you just put it together into one. So, if you have any other mistakes, you have to go back and research. We had to go back and forth to understand and make sure our information was correct.

Girl DB (6.2): During the storyboarding stage, we were putting all our ideas together and if you make a really big mistake, you might have to go and start your whole storyboard all over again. So you have to be precise and know and understand everything before you make the game.

Girl DF (6.3): When we were making the storyboard, we had to relate it to teach people how the Iroquois made their government decisions. So we really had to look at like what we were going to do, and when we were drawing the storyboard, we had to see what the landscape was like, for instance. So I learned a lot of stuff through creating our storyboard.

Boy TM (6.4): In the storyboarding we were basically explaining the democracy in Ancient Athens in a simpler way for us to understand it easier and to let other people who do not know about democracy in Athens and to learn it simply instead of like going through the textbooks and researching and all that work.

Boy UW (6.4): During the storyboarding we were putting all our ideas and research in a way to make it easier to understand when we were going to program our game (Post interview, June 2014).

A further analysis of some of the outcomes of this task’s activities helped to provide possible evidence that support or refute teacher participants’ and students’/groups’ claims for deep learning of the chosen curriculum content as students/groups attempted to communicate their deep understanding of how the citizens in students’/groups’ various models participated in the government decision-making process.

Possible evidence of deep learning of the chosen curriculum content in the storyboarding task. In the storyboarding task, the teacher participants indicated that they used formative assessments along with self and peer assessments with feedback to promote students’/groups’ deep learning of the curriculum content. For instance, during the formative assessment of students’/groups’ storyboarded ideas, the teacher participants used Socratic
dialogue/questioning to encourage students’/groups’ deep understanding of how the citizens in their various models participated in the government decision-making process, as depicted in the following excerpt from one of the Socratic dialogue/questioning sessions between Dave and one group in reviewing the creation/designing of the storyboard:

Teacher: So, this is the clan mother?

Students (all): Yeah!

Teacher: Okay, so from there, what does she do?

Student S: She is trying to find a chief.

Teacher: Finding a chief, okay! So do you have a chief here, a chief here, a chief here? A speech bubble kind of thing?

Students: Yeah!

Teacher: So what’s that going to do through the information that you’ve used on the decisions that the clan mother makes to get this chief?

Student R: This is what the clan mother is looking for when choosing chiefs.

Teacher: Okay! Is that your whole concept or is there more?

Students: There’s more!

Teacher: Nice! So it’s like going to stage 2?

Students: Yeah!

Teacher: So now, you’re a chief? So does the player change into a chief?

Student G: Yeah and he always stays with the clan mother.

Teacher: So a choice is made on chief, right? What’s the purpose of that?

Student D: So the clan mother can find the chief that listens to citizens and matches what the citizens say.

Teacher: Nice! So that’s a good representative, here? What happens after that?

Student S: They’re trying to find the right person for the job.
Teacher: So you as the clan mother, how do you win or lose this game? What’s stopping you from getting there by choosing the wrong chief?

Student B: We going to use obstacles.

Teacher: Tell me about these obstacles. So I’m a clan mother and you are moving me in the game through physical obstacles?

Students: Yeah!

Teacher: So there are good and bad choices! Are you going to explain to the player why he/she chose the wrong chief?

Student B: Yeah!

Teacher: I like it. Make it happen. Green light!

Teacher participants also used a combination of instructional conversations and Socratic dialogues/questioning with feedback to encourage students’/groups’ deep understanding of how the citizens in their various models participated in the government decision-making process. This seemed to be depicted in the following excerpt from one of the combined instructional conversation and Socratic dialogue/questioning sessions between Matt and one group in formatively assessing the creation/designing of the storyboard:

Teacher: Does that say supermarket?

Students (all): Yeah! (Laugh)

Teacher: Do you know that the supermarket has only really been around for maybe 50, 60 years? So when you get a supermarket . . . This says supermarket chat. If I hadn’t brought this up and I’m playing the game and I see supermarket, you’re like two or three thousand years wrong. The same thing I said to them about the poster, I’d say that’s even worse. There’s a chance they did use parchment paper or that old papyrus. There’s a chance they used coal but there’s no way there was a supermarket. Now, market is much different.

Student (all): Ohh, that kind a makes sense!

Teacher: Markets have been around since the beginning of civilization. People would take their chickens, their tomatoes to a market and they would trade. They didn’t use money. Alright so, careful!
Student Y: We also have a bread store.

Teacher: What’s the bread got to do with anything? What does it have to do with the decision-making process?

Student L: He’s moved up to citizen status by giving him the bread.

Teacher: Oh I see! But this didn’t happen at all because it’s not like you could give someone bread back then, right? You know that! That’s not authentic information. I don’t want people walking away saying oh people could go from this level of social structure to this level just by giving someone bread.

Student K: He didn’t know if he was a citizen or not and that guy knows he wasn’t.

Student J: He knew his parents and his parents abandoned him.

Teacher: Oh, he tells them that he is a citizen! He does it in exchange for the bread? I thought the bread bumped him up.

Students (all): Noooo!

Teacher: . . . Okay, military training is excellent and if I were you, I would put it’s mandatory military training. Oh I get it. They know that all boys had to pick the military. Was it all boys or just citizens?

Students: All boys!

Teacher: Even medics? Even slaves?

Students (all): Yes!

Teacher: Did they make slaves fight in the war?

Students (all): Yes!

Teacher: . . . Okay, so this is a magistrate who settles the dispute. Not about the Pnyx, not about the council of 500?

Students (all): That was their choice.

Teacher: Well I don’t see much decision making anywhere else.

Student K: Well, first the man talks about it.

Teacher: Oh, this is the Assembly!
Student K: You have to see it in action. You have to see the council in action.

Teacher: Oh I see! So they’re not really participating. They’re kind of just looking in?

Student J: At the end, he does.

Teacher: As far as the game goes, I’m actually quite interested in playing your game because you have a plan and hopefully your programmer can execute this plan, a bunch of neat helmets. It’s a thorough amount of information. I just wonder how deep you have gotten into each of these phases like the Assembly. How deep is that? Like I don’t want people to say, ‘Oh they had an Assembly’ or they had a council or oh they had a magistrate. How deep is that? Have you used those opportunities to show the research? Where did people meet? How did they know about it? What did they do there? What was the process? Don’t just make the character walk through something which is just an Assembly. There’s a chance that grade 4 or grade 5 actually know that. But you have to use it. In each of those slides, there needs to be involvement from all five group members. It’s not like oh the storyboard’s done. What’s the musician going to do? What’s the artist going to do? What’s the leader’s role in this? Go on that.

During these activities, deep learning seemed evident as the students/group engaged in, for example: critical thinking by exploring, developing, reflecting and critically assessing their new ideas as they created the content of their storyboard with their teacher; higher order thinking by manipulating and combining the research and their new ideas in order to arrive at some interpretation or explanation of how the citizens in their model participated in the government decision-making process; disciplined inquiry by demonstrating an understanding of the problematic nature of their ideas; and active learning by designing their learning through processes of co-construction and interacting and communicating with each other and their teachers through formative assessments and feedback and showing a sense of ownership of the material (Appendix F).

The following excerpts of feedback provided in Edmodo on three groups’ storyboxed ideas (from grade 6.1) are examples of the specific, timely and continuous feedback provided by
the teacher participants for students’/groups’ improvement and to promote students’/groups’ deep understanding of how the citizens in their various models participated in the government decision-making process:

**Teacher feedback-Group 1:** As we discussed, you need to focus your efforts on the portion of the story that pertains to the decision-making process. I would shorten the part about the hostage taking, and get right to the good stuff about the Pnyx. That’s where you will impress. The other stuff is just being used to get you to the voting at the Pnyx. Let your knowledge of that process shine.

**Teacher feedback-Group 2:** Your idea has great potential. I like how your game celebrates your understanding of how petitions are created in an effort to engage City Council. Once your issue gets to City Council, it is IMPORTANT you let your user experience that process. How does it go from there? What role will your player play in that process? I am granting the green light, but on the stipulation that you expand your idea from a 1-stage approach to a 2-stage approach. Get the petition made, and THEN get the issue in front of council for vote. All the while, showcasing your collective understanding of this process.

**Teacher feedback-Group 3:** We aren’t creating digital storybooks; we need action for the player to take part in. I liked the ‘clicking on the councillors to reveal their Vote’ element, but we need more of that. Always ask yourselves the question, ‘What are we showing the player about our understanding of this process?’ That’s the overall MOST important element we need to be concentrating on.

To further promote student’s/groups’ deep understanding of how the citizens in their various models participated in the government decision-making process, teacher participants also encouraged peer feedback through the group-share reflections (see description of activity in Chapter 4). The following excerpt from a video-taped group share reflection (link: https://www.youtube.com/watch?v=7LVspDjOP1U&feature=youtu.be) between two groups on the groups’ storyboarded ideas is evident of that peer feedback:

**Boy GB (group 5):** Now the democracy is started. He’s just taking charge. He’s now bringing order, so now they’re getting back to court so they can report to the council.
Boy MH (group 5): This is what happens if the person makes the wrong move (The town burns down).

Boy JA (group 1): Whoa! I think you should change that. That’s not Ancient Athens. The city is going to burn down. That’s too violent!

Boy GB (group 5): So we now brought back all the houses. Now they’re building back the court.

Boy UD (group 1): I like your idea, but it’s quite ambitious.

Boy MH (group 5): Okay! So we’re going to show a little scene of a battle and it’s not going to show any violence.

Boy GB (group 5): There’re not going to be any bodies. No one’s gonna cry over the dead bodies. There’s not going to be a murderer on the loose.

Boy UD (group 1): Sooo, I like that idea a lot! So our story is much more complicated than our storyboard. Travel back to Ancient Athens to catch proof that an evil organization called ARC (Augmented Reality Codes) is slowly taking over the world using perception filters in the sunglasses. So if you’re wearing these sunglasses, you only see what they want you to see, not what you can actually see. But no one else knows that except for this guy. He did his own research and figured out this is what happened and so, when he travels back to Athens, he finds the mad scientist to invent an invention . . .

Boy MH (group 5): One question: What does that have to do with the decision-making process?

Boy UD (group 1): It’s coming! So, he theorized the perception filter and then he shut it down. The citizens are outraged and demand a referendum, which is part of the decision making, and the government agrees and knocks this company out of business. So what happens in the game is one of these people who work for this company . . . They figured out that he knows and have sent agents back using the same technology to try and stop him. So using the decision-making process from Ancient Athens, he has to say, ‘ostracize these people or take away their citizenship . . . and convince the citizens to ostracize him.’

Girl PT (group 5): I’m just wondering how you’re going to program this.
Boy UD (group 1): It’s gonna be a very complicated game. So it’s basically what’s it gonna be.

While all the students interviewed indicated that their teachers’ feedback did contribute to their deep understanding of how the citizens in their various models participated in the government decision-making process during the creation of their storyboards, several students indicated that the feedback provided by their peers was also invaluable to their deep understanding. Some of their reasons can be captured in the following responses provided, across classes:

Girl YL (6.1): My group got the feedback from another group telling us that we should have more player interaction and just before we started, our programmer had come up with a really good idea for that, and I think that definitely helped our game.

Boy KE (6.1): The feedback that was given to us definitely helped our game. I can’t off the top of my head think of the feedback that my teacher gave us, but I can think of the feedback the group gave us.

Girl PR (6.2): We still do get a lot of teacher feedback but I feel like we’re doing video games so we focus more on what the other group tells us.

Girl PH (6.3): The feedback from the other group helped because we can’t only depend on our teacher for feedback. Sometimes we need peer feedback because not everyone has great ideas all the time, and it helped some people contribute their ideas a bit more.

Boy CN (6.4): I find that, you know, although teacher feedback is quite good, like he doesn’t discourage us, he mostly encourages us by giving feedback to make our design even better. With the kids’ feedback, not much adults play that much games, right? You know kids they like playing games and they can help you because some still play games and they have a lot of experience with it that they have a better understanding of it [sic] (Mid-interview, April 2014).

In their continued effort to promote students’/groups’ deep understanding of how the citizens in their various models participated in the government decision-making process, teacher participants also indicated that they encouraged students to judge the quality of their own work
by allowing them to use elevator pitches with videos (as described in Chapter 4). Transcribed examples of some of these elevator pitches are as follows:

**Girl PC (6.2):** For our game project, I decided to talk about the strengths and weaknesses of our game’s content. Well we have a very strong weakness that we can never overcome, which is that we have a very strong game plan but it didn’t include any decision-making whatsoever. Well we did almost overcome that. Another weakness is that it doesn’t really include all of the research we did. This is because we chose chief, but may be three or four sentences of each answer was about the clan mother. A strength in our game is that our game has a very solid base and will advance very quickly. I think that our game will advance very quickly and end up to be a very good game. Another strength in our game is that the decisiony [sic] parts are very easy to program and that the decisiony [sic] parts are very focused on consensus. The last strength is that our group works very well together after a while and we have consensus on our game plan.

**Girl MG (6.3):** In the game my group and I are making, it starts out with a character and he decides to come on the path of becoming a mayor. I think it accurately reflects on my personal understanding because the game tries to hit on all the main key points of what our mayor has to do for us. It also gives specific examples like trying to alter the times the garbage is being picked up to help everyone. Our character also talks to people on the streets to see what they think about the government and learns what they should do for us. Talking to the reporter also helps our player understand our character better because of what the reporter asks them and what kind of characteristics she thinks that he needs and what he plans to do. It also shows what they have to do and what measures they have to take just to become a great mayor. All in all, I think this game shows my understanding by showing the path and responsibilities of an Alberta representative.

**Boy MX (6.3):** Our main character is from a distopian future and happens to have a time machine. He travels back to the Iroquois to try and save the future and to stop majority voting. By teaching the Iroquois consensus, the Iroquois will teach the Europians consensus and the future will be free of greedy selfish dictators. The player will learn of the matrilanial-based society and consensus being made between Seneca, Oneida, Mohawk, Cayuga and the Onondaga. The weakness in our game is the fact that our main character time travels to the Iroquois time from a distopian future. The reason this is our weakness is because it is completely irrelevant from the topic. Also how an outsider who was not involved in the clan can just walk up to the long house and gain their trust. The strength of our game is the fact that all the scenes blend together nicely and it easily switches from one topic...
to the other. Also the fact that this concept indirectly teaches you about the ways of the Iroquois instead of directly teaching you.

**Boy CV (6.4):** The strengths and weaknesses of my game I think are pretty good. I think it has some weaknesses and some strengths but I can work on them later. My strength is that when the player plays the game, he doesn’t actually realise that he is actually learning, but he is. So, it’s better that way for the player. So, it makes sure like he is not like really in the learning zone. He is not in a learning game, just more of a calm relaxed game. He can actually play and learn at the same exact time. Also what I like about the game that’s there’s different questions throughout the game and the questions vary from really hard to really easy depending on where you are or where you’re trapped. Some of the weaknesses I think in our game, you do learn but there’s only certain points of the learning like you could learn more, but we just haven’t had enough time to incorporate that much learning into it. But you still learn at certain points. Also I think that we had difficulty researching good information that’s in Ancient Athens for representative democracy cause well it’s kind a out of the ordinary but we want to make that as a challenge. I think that also there’s only one level. There’s no easy level, no hard level. I think that also affects it and also I think that our game is hard to make and it will take a while to make, but it’ll be good. That’s my Age of Athens video game.

During this activity, students seemed to be engaged in deep learning, for example:

- knowledge creation by reflecting on their own and peers’ knowledge and ideas in developing the content of their storyboards, from their points of view;
- critical thinking by evaluating their ideas as they recognize the strengths and weaknesses in these ideas;
- higher order thinking by analyzing and synthesizing their group’s combined research and ideas in an effort to explain how the citizens in their model participated in the government decision-making process;
- active learning by examining their ideas critically, while evaluating their own progress and showing a sense of ownership of the material (Appendix F).

Other examples of these elevator pitches with links to the actual videos can be accessed in Appendix S.

Teacher participants also commented that the end products of the storyboarding process, the resulting storyboard artifacts (see examples from groups’ Google documents in Tables 20-21 and Figures 28-29 and Appendix O), helped to effectively communicate students’/groups’
creative knowledge and deeper understanding of how the citizens in their various models participated in the government decision-making process and what they intended to use as the domain knowledge in their game prototypes. According to Matt,

The kids made wonderful storyboards and they used their creativity and they used their knowledge on their chosen genre and they made these wonderful detailed storyboards. I’m glad they have the storyboards because I can see what they intended to create. With the storyboard piece, every member of the group was engaged and had made plans and were able to kind of articulate what they were going to do (Post interview, June 2014).

Table 20

Descriptive Storyboard for The Clan Mother

<table>
<thead>
<tr>
<th>Game idea:</th>
<th>The player starts as a clan mother and hears there is a meeting at the long house. The player is trying to get to the long house but there are a lot of obstacles in the way. On the way to the longhouse the player meets 5 citizens which each need something. The Clan Mother talks to citizens about their problems. Then she will ask the 4 Chiefs about the issues and what they would do to resolve those issues. The 4 chiefs each explains why they should be chosen as chief. The player has to pick which chief should be choosen.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Obsticals:</td>
<td>Citizen #1: I have kids and their hungry because someone stole my hunting tools. Please Help! Citizen #2: My grandma is very ill and we don't have any medicine. I need Help! Citizen #3: There is a tall tree blocking the sun so my crops can't grow. Please Help! Citizen #4: My family is getting really sick because our water is getting dirtier every day. I need Help! Citizen #5: There was a small rock slide and it's hard for my family and I to get to our house.</td>
</tr>
<tr>
<td>Qualities of chief:</td>
<td>With stand criticism Ability to think clearly Loyalty to family Ability to represent the people fairly Honesty Kind-hearted</td>
</tr>
</tbody>
</table>

(table continues)
Chief#1:
I will make sure we equally supply clean water and make sure medicine is provided. I will also make sure there is a clear path for crops to grow.
Traits: Very sensitive, Liar, Rude

Chief#2:
I will make sure our horses are fed and the trees will always stay green. I will make sure our shoes are always clean and all the citizens will love our cheese.
Traits: Discards family, Not organized, Ignorant

Chief#3:
I will make sure every family is well fed. I will make sure the rocks are cleared and the river is clean.
Traits: Can withstand criticism, Can think clearly, Loyal to family, Ability to represent the people fairly, Honesty

Chief#4:
I will invent the best water filter to filter our water and no one will ever get sick in their lifetime. I will make sure that we get a new bunk bed for the longhouses.
Traits: Kind, Upbeat, Able to represent people, Smart

After listening to the Chiefs solutions the Clan Mother will pick the Chief they want to lead their Clan.

Table 21

Descriptive Storyboard for Lost with Clues

Game idea:
A metic travels around Athens and gets 5 clues along the way about democracy and has to go where the clues direct him. The main goal is to get to Hymettus Mountain. At each clue it directs somewhere in Athens. When you get to the mountain you put all the clues in the door of the cave and then the cave opens and you save the mythical creature.

Characters:
Main characters: Cyrus Sapphonian
Pet Eastern Mountain Gryphon (name spelt accordingly) name: Nikon
Nikon was found at age 6, age 23

Story of Cyrus Sapphonian:
Cyrus was born out side of Ancient Athens but found a pet that's a griffin named Nikon. Cyrus is an metic and loves his secret pet Nikon because he has nobody else to love and care for. Cyrus is tall with deep blue eyes with golden brown hair he wears ripped cotton clothes but has a deep heart.

Sound/music:
Prologue/Intro: Birds chirping, wind, leaves falling/crunching, rock crumbling down, water rushing, crackling fire and footsteps. It's really realistic with sound and it's not loud music.
Clue 1: Water rushing down, footsteps, people chatting
Clue 2: Smoke coming out of the chimney, crackling fire,

(table continues)
Clue 3: Crackling fire, people chatting,
Clue 4: Chatting,
Clue 5: Background music

Clues:
1) A clue floats to him on the ilissus river: Take the path along the way to where your parents went. There you will find where gods and humans decide. Once they make a decision, Look at the last spot your people stood and find your next clue. Finds first clue he looks under the stone where his parents last stood that's where the clue is.
2) Looks under the stone and finds clue: Go to the houses under the hill, at sunrise no later and learn about their life. At sun set go to where the fire crackles and you will find your clue. But don't be seen for it will be the last for you. At sunset he goes to the fireplace and pulls the clue from the fire.
3) Pulls clue from fire: Go to the place that is dedicated to the god Athena. This place is high above the city in the center of town. You may know of this place as "The Sacred Rock, the high city" but for many it is known as something else go that place and learn it's ways. Your clue you will find high up in the building it will appear only after learning. At sunset Find the clue on high up in the building on a ledge
4) Grab clue from the ledge: Go to the place where people gossip, trade and sell. There you will learn more about democracy, and how the people buy. This place is the first for democracy where everything came to life. Listen to peoples conversations then go buy the chest with the red dot and open it up. Before sunset he goes and buys the chest then exactly at sunset the chest opens and reveals the clue
5) gets clue from chest

Link to Storyboard: https://www.youtube.com/watch?v=umD8PwL1Vms&feature=youtu.be

Figure 28. Visual storyboard for Lost with Clues
In creating these storyboard artifacts, students/groups seemed to be engaged in deep learning, for example: knowledge creation by collaboratively constructing and negotiating new knowledge using varied information sources, and integrating that new knowledge and understanding with previous experiences to create their storyboards; critical thinking by reflecting on different points of view from their teachers and peers to develop and structure their new ideas and solutions into storyboards; higher order thinking by manipulating and transforming the research and their new ideas into formats (including visuals) in an effort to explain how the citizens in their model participated in the government decision-making process; active learning by working collaboratively to make connections with their game concepts, designing learning through processes of co-construction, as they interacted with each another and their teachers, while approaching the same material in multiple ways; and communicating the results of their shared understanding of how the citizens in their model participated in the government decision-making process (Appendix F).
Teacher participants and students also claimed that as the storyboards were being created, the role-specific skills, particularly, in story writing, art and music, seemed to facilitate that deep understanding of how the citizens in students’/groups’ various models participated in the government decision-making process. For instance, in commenting on their development of music and art for the game, Dave stated that,

in developing the music, [students/groups] had to try to make it as close to that culture as possible. They couldn’t just use any music in their games. You could see they were trying to apply that learning because one student said, the music sounded so techno, it didn’t reflect the Iroquois culture. One of the artists said that he couldn’t just pull done images from the Internet. He had to try to make it look like what was happening there at the time. You see and hear how deeply they were thinking about it as they learn so much about the culture from their roles (Post interview, June 2014).

Matt added,

What’s interesting is when I listen to that music, I won’t know what they think about that music. So, by having them reflect on why they made those choices to me is very much more important than just listening to the music because the music to me, might mean nothing, but to them, they could probably talk like what was going through their minds when they created that music (Post interview, June 2014).

In the post interview, the following responses from some of the students, across classes, also captured how, they believed, their roles facilitated their deep understanding of how the citizens in their various models participated in the government decision-making process:

**Girl HS (6.1):** I was the story writer and that really helped me to learn more about our topic because some people say to study, you should like rewrite all your notes. Well, I kind a had to do that because I had to write all the captions for the scenes and I had to make sure the story had accurate information to go into the story line.
Boy MT (6.2): Well, being an artist, not only that we are getting to work with some of the Ancient Athens or the Iroquois or the modern day. We were learning about decision-making process in our art.

Girl SN (6.2): I felt challenged at the beginning because we were making our game on the Iroquois confederacy and I know the Iroquois confederacy is really old and I had to make music that sounded really old and I was not quite sure how to do that. Then I played around with Garageband a bit and I had to decide what sounded close to the Iroquois without making it sound like a bunch of blobs of sounds.

Girl PT (6.3): I learned a lot when I was actually writing because I did have to do some research on the side to make sure the information I was using was accurate. Like what’s the Iroquois name for certain items and other interesting facts I found pretty cool. So, I felt that these facts were interesting so I paid attention to them when I was writing the story.

Boy MX (6.3): I was the musician, so I did all the music and even when I was doing the music, I was learning a lot about the Iroquois through the music. It was like when I watched the videos and stuff about it, it showed more about their lifestyle and it helped me with the music.

Boy UR (6.4): As the programmer so I got to do most of the decision making in the design and all. So, I learned a lot from this. I learned about the topic probably more than any other role. As a musician, I have learned a lot about the music from that time (Ancient Athens). Now I got to understand all of it, not just one thing (Post interview, June 2014).

Possible evidence of deep learning of role-specific skills and technologies in the storyboarding task. Teacher participants and students indicated that in the storyboarding task, not only did the role-specific skills facilitate a deep understanding of how the citizens in students’/groups’ various models participate in the government decision-making process, there also seemed to be deep learning of these role-specific skills, particularly, story writing, art, music and leadership skills. According to Dave, “We were seeing talents in different ways like reading and writing skills, different artistic skills, music skills and leadership skills” (Post interview, June 2014).
In their conversations during the post interview and in their Kidblogs, some students, across classes, also pointed out how they became more skilled in their roles because of their activities:

**Boy MT (6.2):** I was the artist for my group, so, I was improving on my drawing with my group members helping me with the artwork that I worked on.

**Girl DF (6.3):** I learned how to create music using Garageband. I didn’t know how to make music out of Garageband before and I’ve never really done anything like that before. So, that helped me develop skills in making music.

**Girl MG (6.3):** It really helped me learn more about the technologies. I haven’t used a Mac laptop in a while and so, I was surprised at how much I had forgotten. I relearned all those things that I had forgotten, but I felt that I was learning something new and then I also learned to create music.

**Boy UW (6.4):** With the music I did it creatively. There were a few challenges that I ran into when working in GarageBand, which is very limiting instrument wise and does not compare to real instruments. I overcame this challenge by downloading different apps that specialized in one instrument, say a drum app. This was very helpful because these apps are more realistic than one big app with everything in it (Kidblogs, June 2014).

**Boy CU (6.4):** My group, we discovered like 10 new apps and used them to incorporate into our Scratch project. Like we had this app called Sketch pad which was really good for creating art for our games, like backgrounds and characters. One called pixel art, one called Bamboo, Notebook, those were some of the main apps we used (Post interview, June 2014).

In using their role-specific skills, students seemed to be engaged in deep learning, for example: collaborative construction of new content for their storyboards, using varied information sources to promote and demonstrate their deep understanding of how the citizens in their various models participated in the government decision-making process; critical thinking by exploring, developing and using their skills to create the content of their storyboards; higher order thinking by using their skills to transform and communicate their new ideas into the
storyboards; active learning by using their skills to become actively interested in creating and designing the content for their storyboards and showing a sense of ownership of that content (Appendix F).

Possible evidence of deep learning of the game aspects or game design principles in the storyboarding task. Deep learning seemed to have taken place, not only on how the citizens in students’/groups’ various models participated in the government decision-making process and in students’ role-specific skills and technologies, but also in the use of the game design principles. In formatively assessing students’/groups’ storyboarded ideas, through discussions with feedback, for instance, teacher participants also seemed to encourage or promote a deeper understanding of the game aspects or game design principles, as may be evident in the following excerpt from one of the discussion and feedback sessions between both teacher participants and one group as they reviewed the group’s storyboard:

**Teacher Dave:** Do you know what the movements should look like? Does the person come forward to this or is he standing still?

**Student H:** He moves the character from here to there.

**Teacher Matt:** Then what happens next? Do we move to the next scene? It’s evident to me that you put a lot of thought into it. Is it going to be a fun game for the player to play?

**Student F:** No!

**Teacher Matt:** Why not?

**Student D:** It’s not done yet. The story needs to get told to him as he moves the character around a little bit.

**Teacher Dave:** Is this about taxes or is this about how they made decisions regarding taxes? Because the assignment wasn’t to talk about taxes.

**Student D:** We’re just using taxes as an example to show how they made decisions for tax increase for war. And then we do some debates.

**Teacher Dave:** Oh, I remember we talked about that. It wasn’t just walking about.
Student T: We got them to disagree, agree. Then there’s speaking, debating and listening and then there’s a discussion part.

Teacher Matt: Does the player take part in this somehow? Does he walk up to somebody at least? Like maybe he can talk to as many persons as possible or something like that so you have to kind a control the player. The point is, there was discussion that happened. Good! You are also making a game so let’s beef up the actors.

Teacher Dave: Add more beef, literally! Then flashback!

Teacher Matt: What happens here for action, programmer, during the vote? I see the stairs. Are you moving them up the stairs? Are they going to jump off over here?

Student T: They drop a point.

Teacher Matt: Nice, use that word. Alright, so there’s action here. And then for this counting, is there action?

Student S: Yes, in the controls.

Teacher Matt: Alright, green light! But you know what, I think you do need to sit down and say what’s the artist going to do on this and what’s the musician going to do on this and then the programmer what action is each slide gonna have. I don’t want to see a story played out like I’m sitting at my computer hitting next, next, next. I want to play it.

During this activity, in collaboration with their teachers, and drawing from their video game playing experiences, students/groups seemed to be engaged in deep learning, for example: higher order thinking; disciplined inquiry; active learning; knowledge creation by integrating new knowledge and understanding with their own prior experiences to contribute new ideas to the design and building of their storyboards and game prototypes; and critical thinking by exploring, comparing and structuring their new ideas and solutions with their teachers (Appendix F).

Students’/groups also seemed to have applied the following game design principles as they created their storyboards: drawing appealing visuals in an effort to support and enhance the content and engage their players; attempting to present clear goals and objectives that the player had to accomplish while playing the game; attempting to implement clear game rules, increasing
levels of difficulty to challenge the players, feedback cycles and a reward system; ensuring that the game is appropriate for their target players’ skills level, easy to use so that the player can concentrate on the objectives set within the game without frustration; motivating the players and making it fun to play.

Deep Learning in the Programming Task

In the programming task, (as described in Chapter 4), students/groups’ engaged in the coding/programming of their storyboarded ideas based on their game concepts using the game software/Scratch, in an effort to communicate their deep understanding of how the citizens in their various models participated in the government decision-making process. Teacher participants, however, indicated that deep understanding was not as evident/apparent in the coding/programming of students’/groups’ games and resulting game prototypes as when they brainstormed, researched, debated, discussed and developed their game concepts and storyboards. Matt explained,

if I looked at the game as proof of their deep understanding, I think we would be scratching our heads a little bit. Thinking, I don’t know if it shows or exposes enough of the curriculum or aspects of the unit. But all of that front loading when they went into their research and created their storyboards, I think that’s where or that’s the point of the project we can say yes, I feel confident that this child knows and understands this curriculum. The game is sort of the icing on the cake (Post interview, June 2014).

In providing possible reasons for this outcome, Matt explained that,

when it came down to programming their storyboards, [students/groups] lost a lot of the detail because they were limited to understanding how to make that game to represent what was on that storyboard. The challenges we had logistically with making sure they
had access to a laptop, even the full features of it, I think that played a significant role in this transition and was a major obstacle (Post interview, June 2014).

In agreement, Dave continued that,

once the storyboard was finished, that’s when like the real difficult part happened and you could really see the difference in groups if they have someone who is well versed in Scratch as the programmer, versus somebody who is struggling with Scratch. When they switched from storyboard to actual product, then I think their plans had met with a little derailment (Post interview, June 2014).

One student’s description of this transition and echoing the experiences of most of his peers, confirmed what teachers and the researcher had observed about this transition. He explained, “One problem we found was that we had all these ideas but it was really hard to incorporate the massive bubble full of our ideas into the really small bubble and putting it all into Scratch because Scratch is very limited” (Post interview, June 2014).

Therefore, about 98% of the students, interviewed, indicated that in engaging in the coding/programming of their games (prototype 1), they were much more focussed on trying to build their storyboarded ideas into Scratch and to make their games playable. A blogged reflection from one of the programmers helped to capture his thinking behind that focus during the programming task. He stated, “I felt that building the scripts [coding/programming] was a very big part because you’re creating the game and you’re putting all of it together and you’re actually finally get to see how it’s gonna turn out and how’s it’s gonna be like” (Kidblog, June 2014).

As such, a deep learning of the game software/Scratch and game aspects or game design principles seemed more evident than students’/groups’ communicating their deep understanding of how the citizens in their various models participated in the government decision-making
process. According to Dave, as the students/groups, particularly the programmers tried to “figure out how to work out that game software, they see it as deep learning for sure and that’s what I think it is (Post interview, June 2014).

Matt also stated that, “Looking at the reflections from all the groups’ members, there were some programmers I think who really did expand their knowledge on how to program” (Post interview, June 2014). Some programmers’ responses, across classes, seemed to capture their deep learning experience in programming their game prototypes:

**Boy VN (6.1):** For me, it really improved my programming skills because before this project, I didn’t really know how to program a video game or anything like that.

**Girl DB (6.2):** I was the programmer so I learned how to use the Scratch program and I learned how to get all the backdrops and the scripts and the storyline all in, for my group.

**Boy SK (6.3):** I think sometimes we learned a little too much and that’s like great because not only did we learn how to program or draw in the Scratch program, we also learned stuff like making characters move from one place to another. It’s like not only did we learn the education part of it, we also learn how to program and to make it really seem impressive.

**Boy UR (6.4):** I did know about Scratch before and I feel like I really learned how to use it better. Like I had a basic understanding and that really helped to advance it and to really get going. I really got to know how to work Scratch (Post interview, June 2014).

Examples of scenes from the first prototypes of three games (see Figures 30-33; see Appendix O for more examples of game prototypes) seemed to support the focus on programmers developing their expertise in using the game software/Scratch and game design principles (gaming, learning and technical aspects) rather than communicating their deep understanding of the curriculum content which they had researched, discussed, analyzed and synthesized in their game concepts and storyboards:
Figure 30. Video game prototype 1 scenes from *Journey to the Onondaga Clan*

Links to game prototype:
http://scratch.mit.edu/projects/21714107/

http://scratch.mit.edu/projects/21714107/#editor
Figure 31. Scripts for scenes 1-6 in Journey to the Onondaga Clan prototype 1

Figure 32. Video game prototype 1 scenes from Ancient Athens Scratch Project
One student, however, indicated that in their group, coding/programming the game prototype also helped them to communicate their deep understanding of how the citizens in Ancient Athens participated in the government decision-making process because as they coded/programmed the game, they always needed to review the research to ensure that they were using accurate content to fill in the small details of their game concept:

*Figure 33. Scripting for scenes 1-6 (among others) in Ancient Athens Scratch Project*
In building the game, it helped to deepen our understanding of the Ancient Athens, that’s what my group chose. We would program something and then we would say, “Oh, they must have done this”. We’d look it up and it was correct we did, to fill in the small details. We just had to do more and we wanted to do more research. (Post interview, June 2014).

The following examples of scenes from their game prototype 1 (as seen in Figures 34-35) seemed to support the focus on both the game design principles (gaming, learning and technical aspects) and the curriculum content which they had researched, discussed, analyzed and synthesized in their game concepts and storyboards:
Part 3 is not finished: http://scratch.mit.edu/projects/24810106/

Figure 34. Video game prototype 1 scenes from Athens Adventures

Figure 35. Scripting for scenes 1-5 and 11-14 in Athens Adventures prototype 1
Possible evidence of deep learning of game aspects or game design principles and game software/Scratch in the programming task. As students/groups attempted to code/programme the storyboarded game concepts, some of the themes depicting deep learning (as seen in Figure 16 and Appendix F) of the game aspects or game design principles and game software/Scratch seemed evident. For instance, despite the limited amount of curriculum content presented in most of the game prototypes (as seen in examples of game scenes and coded scripts in Figures 30-33 and in Appendix O), programmers, assisted by their group members, coded and scripted their art, dialogues and music to create their first prototypes guided by game aspects or game design principles (e.g., appealing visuals to support and enhance the content and engage their players; clear goals and objectives that the player had to accomplish while playing the game; clear game rules; increasing levels of difficulty to challenge the players, feedback cycles and a reward system; ensuring that the game is appropriate for their target players’ skills level; easy to use so that the player can concentrate on the objectives set within the game without frustration; motivating the players and making it fun to play).

In developing the game scenes, the programmers, with the assistance of their group members, seemed to engage in deep learning, for example: knowledge creation; critical and higher order thinking with mostly their peers; and active learning. Programmers, with their group members, particularly used complex forms of communication, such as iMessages, FaceTime, emails, ‘runners’, to conduct their work and to present its results. They also continuously assessed and improved the quality of their prototypes informed by continuous, timely and specific peer assessment with feedback (Appendix F).
Conclusion on Deep Learning in all the Learning Tasks

In further commenting on the students’/groups’ deep learning during all the learning tasks, Matt reiterated that because of this learning experience, he thought that all of the students/groups will have a deep memory of how the citizens in their various models participated in the government decision-making process for a long time. He commented:

If you were to interview these kids five years from now, they will have a deep memory of the particular decision-making model they used as the basis for their game. You know, I think it’s very much embedded in their memory now and they would have this story that they are so committed to and so connected with to help understand how decisions were made like for instance, in Ancient Athens. And because they have that strong foundation of knowledge, I think all the other little details like where the Ancient Athenians met and who voted, I think they will all retain that information for a long time (Post interview, June 2014).

All the students tended to agree, which was captured in the following comments about the project by some students, across classes:

Girl HS (6.1): I think the more we did it, the more we will remember it. This was pretty unique making a video game, so I will remember what I learned here for a long time.

Boy WP (6.1): It’s kind a like something our teacher said. If you see a man walking along the street, and then you talk to your friend next day and you probably won’t remember that, but if you see a guy with 3 eyes and wacky hair or something, you’re probably going to remember it. It’s kind of the same thing: the game is kind a like the guy with the wacky hair and 3 eyes instead of regular presentation or something like that, being just the man. I think I will remember what I learned in this project for a very long time.

Boy JL (6.2): The process was pretty hard and you don’t like remember something that was really easy and stuff, but since it was very hard, I will remember.
Boy UM (6.2): Well it’s cool! Usually you could do that as a hobby, not as a part of school. I will remember it because it’s something unique. It’s not something like you do everyday.

Girl DB (6.2): It was a really good way to learn and we went on a deeper level and we’re going to remember this. It’s going to be a lot easier to remember having done so much research on it.

Girl SE (6.3): It made us remember it because we were dealing with the same thing for a longer time.

Boy SK (6.3): The game design was a really good way to kind of get our topics stuck in our minds in a way to remember it in the future. It will help me to remember it for future references and put it to good use (Post interview, June 2014).

Impact of the Design and Building of Digital Video Games on Students’ Intellectual Engagement

In this research study, the impact of digital video game design and building on students’ intellectual engagement was analyzed based on the following intellectual engagement themes: flow, motivation, effort, enjoyment, interest and relevance (Parsons & Taylor, 2011; Wilms, Friesen & Milton, 2009). These themes are described in the Classroom Observation Protocol for Student Intellectual Engagement (see Appendix F), and were used to guide researcher observation of students’ intellectual engagement as they participated in the learning tasks’ activities. Based on researcher observation, the intellectual engagement themes seemed evident in all the learning tasks, but overall, it seemed to be most evident in the storyboarding task (as depicted in Figure 36).
More specifically, it was observed that as students/groups participated in the game concept development task, the data seemed to indicate (also see Figure 37) that throughout the task, interest, enjoyment and relevance were evident in all 14 sessions, compared to flow, motivation and effort, which were evident in 12 of the 14 sessions.

Figure 36. Radar graph showing evidence of student intellectual engagement in the game concept development, storyboarding and programming tasks

Figure 37. Bar chart showing evidence of student intellectual engagement in game concept development task according to sessions
In the storyboarding task, the data seemed to indicate (also see Figure 38), that throughout the task, motivation, effort, enjoyment, interest and relevance were evident in all 18 sessions, compared to flow which was evident in 16 of the 18 sessions.

![Student Intellectual Engagement in Storyboarding Task (n=18)](image)

*Figure 38. Bar chart showing evidence of student intellectual engagement in storyboarding task according to sessions*

Throughout the programming task, the data seemed to indicate (also see Figure 39) that enjoyment and relevance were evident in all 42 sessions compared to flow, motivation, effort and interest which were evident in 34 of the 42 sessions.

![Student Intellectual Engagement in Programming Task (n=42)](image)

*Figure 39. Bar chart showing evidence of student intellectual engagement in programming task according to sessions*

To probe further into these findings, I used the mid- and post interviews with teacher participants and groups of six students (at least one member from each group) in each grade 6
class, and excerpts from all the students’ Kidblogs. This helped to substantiate my observations and to provide further evidence of the ways in which students’/groups’ design and building of their video games seemed to impact their intellectual engagement, while participating in the learning tasks’ activities. One of the main observations resulting from mostly student responses/comments in the interviews and kidblogs was the obvious relationship between the intellectual engagement themes (flow, motivation, effort, enjoyment, interest and relevance), as one depended or led to the other in students’ intellectual engagement experiences during the tasks.

Teacher participants stated that throughout the learning tasks’ activities, intellectual engagement was highly evident, reiterating their comment earlier that it was an inherent feature/characteristic or by-product of the design and building of digital video games. Matt explained, “There is a high level of intellectual engagement, that’s for sure. The buy-in is there, especially with this group who is surrounded by technology every day in school. So, there wasn’t really a steep learning curve when it came to jumping into this type of program” (Mid-interview, April 2014). Dave added, “We definitely see intellectual engagement across the board” (Mid-interview, April 2014).

Based on their responses in the mid- and post interviews, most of the students/groups seemed to support their teachers’ views that they were intellectually engaged as they participated in the learning tasks’ activities. Their responses to questions posed on the intellectual engagement themes helped to describe their intellectual engagement experiences during the tasks.

**Interest**

Overall, about 92% of the students interviewed (mid- and post) indicated that their participation in the learning tasks’ activities stimulated and helped to sustain their interest in learning and understanding how the citizens in their various models participated in the
government decision-making process, more so, in the game concept and storyboarding tasks than in the programming task (also depicted in Figures 36-39). Their reasons for this interest were captured in the following responses from some of the students/groups, across classes:

**Girl YL (6.1):** It’s a different way of learning so I just find it really interesting.

**Boy CH (6.2):** I thought the activities were a lot better than they would have been if they were to say to make a presentation about either of the three topics because this way you get to have a bit of group work that you have to work on and we each have our different roles. So it interested me a lot because it’s not like Pages.

**Boy SL (6.3):** I thought it’s much more interesting because it’s something different. It’s much more challenging and you have to be creative if you want to be good at it. If you’re making a presentation, it’s quite simple. You put in your facts, find a picture and put in the title and you have a slide. You repeat that a couple times and you have a presentation. But with the game, you have to come up with a storyboard, you have to come up with the elements and you have to be creative about it.

**Girl SO (6.3):** I find it very interesting because it’s very creative and it’s a different way to actually put a presentation. And you get to kind of design your things and everyone has a different role.

**Boy HY (6.4):** I’m really interested in learning about consensus and we could give other kids a different opportunity. Instead of learning like straight from a text book, we could give them an opportunity to learn from a game how a consensus works (Mid-interview, April 2014).

Interest, however, seemed to wane due to role-specific issues, particularly in the programming task as described by about 8% of the students interviewed:

**Girl HS (6.1):** At the beginning I had a lot of work to do because I was the writer. But near the end, I didn’t really have anything to do. So, I kind a lost interest. But then, I helped with the art.

**Boy HN (6.2):** I felt I lost interest at the end of the project because my role had been completed and I felt that I didn’t have a lot to do. I started helping our musician with some of the music pieces and that kept me on task.

**Boy JL (6.2):** The weeks before the Scratch project was over, we pretty much had everything. It was just all up to the programmer, so everyone was just kind a off doing their own thing.
Boy UM (6.2): I felt like when it was in its finalizing and finishing stages, some of our group members, like the musician and the leader were kind of fooling around a bit cuz they had nothing to do. So they were kind of bored (Post interview, June 2014).

Relevance

Students’/groups’ interest seemed to be further stimulated by the relevance of the tasks’ activities. Overall, all the students interviewed (mid- and post) indicated that all the learning tasks’ activities were relevant to (i) their learning about how the citizens in their various models participated in the government decision-making process then, compared to how it is done today, and (ii) future roles in their own lives. Some of their comments, across classes, helped to explain this relevance:

Boy AB (6.1): I feel that it helps us with learning about decision making today because we can learn more about where it started.

Girl NF (6.1): Ancient Athens and Iroquois is kind of the root of democracy, which kind of help us learn about how our government makes decisions. Like there’s majority rules and all and I think it taught me a lot in a creative way.

Boy CH (6.2): We are making our game about Ancient Athens cuz that’s basically how it all started. So, we can see how it has changed and then developed over the years.

Girl KE (6.2): While making our video game, we also had to do some research. So that allows you to get the basic knowledge and so you can understand what’s actually going on in governments and democracy.

Girl SO (6.3): I’m really liking this project cause it’s helping me learn about decision-making processes because in class, sometimes you just lose interest when the teacher is just talking. But when you can just like make a game and actually use it yourself and you add information to the game as well, I feel it’s helping me to understand about the decision-making process today and what Nenshi (Mayor of Calgary) does a bit (Mid-interview, April 2014).

Boy OD (6.1): It let us create how it was different back then for the Iroquois. They had a very different method for making democratic decisions from today. Back then, making decisions was a lot longer. Everyone was
happier but it took way longer. Like for an important decision, they would have to go through all six nations and it would take many months because different tribes would come together and then, if one person wasn’t happy, they would have to start over. But now it’s majority. Most of the people in the city are happy, but if there is a select few that aren’t, it’s kind of a trade-off, but it’s way quicker to make decisions.

**Girl HS (6.1):** Like elections today, before the people get elected, they try to prove their point. They go through a whole bunch of speeches, on why they should be elected and what they’re going to do and why they’re going to do it. It still takes a while but definitely does not take as long as the Iroquois.

**Boy DX (6.2):** This project will help with life skills, in general. I learned to understand other people and that you can’t always be the leader. You have to use other peoples’ ideas and sometimes let other people lead the group.

**Girl DB (6.2):** Group work was one of the biggest things that we learned in this project. It’s gonna carry on into our future and any job that we have and it’s about like all people having different roles and putting them together and then creating a final product.

**Boy UM (6.2):** It can help you if you want to become anybody who works with computers or makes video games, or if you’re going to be an artist or story writer, you could help with the major companies who make video games. You can help them design their games and the leader, well I guess, it’ll be helpful like leading groups in projects when you’re older. [sic]

**Boy JA (6.3):** It’s kind of like a gateway if you ever want to become like someone who works with computers for a living. It can kind of introduce you to jobs like that.

**Boy SK (6.3):** My group was focusing on modern day and if you look at modern day, you can pretty much point to exactly where this project comes in handy. You can exactly point to an election. You can exactly point to the office, the council meetings, the cities. You can definitely tell where this happens in real life. You can tell where it goes wrong and where it goes really well.

**Boy AU (6.4):** I think it will help with group work because I’m pretty sure no one here got to work exactly with all of their best friends. So they worked with people they would not usually work with and different people have different ways of working and if you learn to work with them, you will be a much better group member (Post interview, June 2014).
Motivation

High interest and relevance also seemed to stimulate students’/groups’ motivation to participate in the learning tasks’ activities, particularly during the storyboarding task (as depicted in Figures 36-39), as they tried to achieve the goals of the tasks, do their tasks’ activities very well, remain on, and complete their tasks’ activities and work well within their groups. Matt explained that the high level of motivation seemed to be stimulated by the context of the process as well as the nature of the students. He commented:

I think when there is a product that’s going to be shared with others, there’s a motivation to not look silly and to not look simple. By nature of the type of learner we have here, we have some high level kids who are quite ambitious. So, chances are there are few kids in the group that would be happy with something that’s mediocre. So, is that replicable of other teaching contexts? I’m not sure, but it’s worked here in this context (Post interview, June 2014).

While about 83% of the students/groups interviewed indicated that they were motivated to participate in the tasks’ activities mostly because of their roles, 17% indicated that they had become demotivated to participate mostly in the programming task for various reasons. Some of the reasons for this demotivation included, role-specific issues, the slow rate in producing the needed information from some group members, difficulty in coding and scripting storyboarded ideas, some group members going off task and technical difficulties with the hardware, as captured in comments from some students, across classes:

**Boy AM (6.1):** I was told that I was not doing a good job as a leader and I felt like I couldn’t handle it. And so I just felt like I wanted to quit because they made me feel unsure of myself.

**Boy TN (6.1):** There were some days when I just didn’t want to do my job. Like I kind of just wanted to just stop or just not do it and kind of just switch to a different role.
Boy OA (6.2): Like nothing was going, nothing was moving, just tiny tiny bits forward. I really wanted to stop there.

Girl OR (6.3): When I was doing the programming and the artist didn’t have much done and I had nothing and I was like literally so frustrated, I had no idea what to do. I wished I could get to do something else at those times and really wanted to quit.

Boy SK (6.3): With our group, I got a hold up on our characters from my artist and I kind of felt I wanted to stop because also our story writer, she made the story really complex for me. That stuff I didn’t think I could do because they were really hard. At that point I was, how are we’re going to do all this when they’re holding me up and I’ve got tons and tons of work to do and it’s gonna be really complex and hard for me to do, and I thought at that point, to give up.

Boy CU (6.4): Well a few people in our group went off task and we didn’t get very far because we did not have backup downstairs when we were upstairs on the laptops and then eventually it started getting really, really hard to finish up our game. I wanted to stop.

Boy AU (6.4): Usually when we were on the laptops, it took longer than expected and we could barely get work done in one day (Post interview, June 2014).

**Effort**

About 83% of the students/groups interviewed (mid-) indicated that because of their interest in the learning tasks’ activities, they were motivated to put a ‘huge amount of time’ or effort into their work, especially as they tried to overcome the many challenges that they encountered while performing their role-specific activities, mostly in the storyboarding task.

Some examples, across classes, from students’ blogged experiences help to capture that effort:

Boy VN (6.1): I was the programmer and I had to incorporate many parts just to make one slide a good one. One of the challenges I faced was to make the player be able to move from one slide to the next. At first the player could move to the last and then back to the first. I had to look at many different blocks to figure out how to stop that. I experimented with the blocks as well as put them together to see what would happen. I finally came across the right block that stopped the player from just cycling through all the slides.

Boy GC (6.1): When I received my role, I felt confident that I would impress my group with the music I produce, and my abilities. After awhile my
understanding changed a whole lot. This is because I started to think like a composer. I used to think it was all about good music. Then it changed to expressing feeling as well as relating to the attitude of the game. Most of all by understanding my role, I was able to provide help and support the group. But there were a few challenges to my role. For example, Ancient Athens didn’t have all the modern instruments like garage band. So the trouble was creating older sounding to this music like specifically the pan flute which was one of Ancient Athens native instruments. One thing that made it even more challenging is the fact that I created every single piece of music. I must admit I was surprised that with some of the modern instruments I was able to make it sound as if it was from the time period of Ancient Athens.

**Boy MB (6.1):** At first when I began to work on our ancient Athens game and all the plot lines and stuff I didn’t feel all that confident because of how much things I knew would seem a little challenging to me even though it was the art. Once we got a little more into the creating of the game my understanding grew more and more every photo I drew. I also thought the stylus that I used was very helpful because I might not have been able to draw something like that with only my finger on an iPad.

**Girl KE (6.2):** When I first became the story writer I was excited because I have a thing for writing. My first thought was I just had to write a storyline. When we got deeper into the Scratch project I realized and decided that I should write a caption for each slide so that you could see my part in each slide. I thought this was a great idea but then after I added all the writing in I found it looked more like a story. I had some challenges with getting the writing into Scratch. The writing would not do what it was supposed to, and it was very frustrating. When I finally figured it out I had so much writing it took up almost the entire slide. I didn’t want to, but I had to cut back and make the text smaller.

**Boy DX (6.2):** Making sure that all the time, the group was working, helping out group members, and just maintaining the focus throughout the group so that the game was moving along was the challenging part of being the leader. But just that wasn’t the whole part of the challenge. What made it difficult was that I had to do all of that, and helping out with drawings and music and making sure the game was progressing. Don’t get me wrong, I like a challenge like that and it was a great experience.

**Boy RA (6.2):** At first I thought being the musician was going to be a cakewalk because GarageBand is fun and I am pretty good at creating music but over time I discovered that composing music is a lot harder than most make it out to be. When using garage band it involves a lot of playing around with the different sounds, and finding different combinations to make the perfect music. I had lots of trouble with finding the perfect music for the game because garage band is very modern/techno and
our project was set in ancient Athens, therefore my options for music were very limited. Although I came across lots of challenges I did find success. The songs that were completed I was extremely proud of and they fit into the game perfectly. I had a powerful song that was for a suspenseful action scene and a calm song for just a walk in the city. I overcame the challenges I encountered by finding new combinations for the limited choice I had.

Boy SL (6.3): I was artist and I tried many different drawing apps. I narrowed it down to pixel art. I looked for pixel art inspirations on the internet and shaped it into my own because I was strong doing pixelated art. The one challenge I had to overcome was making the map I really struggled with it. I solved it by changing the software and C recommended that I do it in scratch and it worked. I felt better to work on it.

Girl VH (6.4): When I first got the role of story writer, I was fine with it because I knew I was good at writing stories. At first I thought it was just going to write the story for the game but then I realized I also had the storyboard and script to do. The one main challenge I had though was making the learning factor of it not be right in their face. (So basically not making the characters say “the Iroquois used consensus!”). The final product reflects my skill in story writing by having a good, non-complicated story that people can actually understand what’s going on.

Girl CW (6.4): When I first started I was not good at Scratch at all because I had never used it, but after a while I figured more things out. Then when we started the Scratch for the main project I had a lot of challenges as programmer like when on the first project the character kept getting messed up and did a bunch of things it wasn’t supposed to do, but I kept figuring out how to fix them or my groups writer or leader came up and helped or gave me new ideas.

Girl OW (6.4): Was I a satisfactory leader? Even though I was always told not to label people weather I liked it or not, but sometimes that just has to slide in school. I don’t want to be the girl who marks her self high in the sky as the best when in reality she is just skimming the ground. I also don’t want to be the girl that marks her self low for attention. I am not going to be that girl that goes right in the middle, with the basic mark, I want to be more than that. That was what I thought when I first got the assignment. Well I think I achieved my goal by keeping my group on task, and making sure that everyone got things done the best they could. I am owning up to not being the perfect person or group member but I DEFINITELY think I did a noticeable job in scratch. I am proud because I took one giant leap out of my comfort zone (Kidblogs, June 2014).
Flow

Dave stated that one of the biggest things he observed in terms of that flow state was some students becoming so involved in the activities that they became unaware of the time as well as their surroundings. He commented on a conversation he overhead in one of the groups describing this experience: “There was one group, I overheard talking. They went to visit the programmer and they said that they felt that the programmer did not even realize that they were there with him. He was so into it and that’s a little bit different than lots of the stuff that we do” (Post interview, June 2014).

Despite the few instances when they would go off task, about 83% of the students interviewed (mid-) indicated that their interest, motivation and effort helped their groups to experience that flow state. They explained that as their groups participated in the learning tasks’ activities, they were completely involved, focused and concentrated on their role-specific activities. Some of their responses/comments, across classes, captured these experiences:

**Girl NF (6.1):** I worked pretty hard because I’ve been drawing all the scenes in the storyboard. So I feel very involved in what I’m doing. In every single class, almost, it’s like make a Pages document for this, make a Pages document for that, and now we’re really getting to do something else, which gets me more involved in contributing towards my learning about the decision-making process in the Iroquois confederacy.

**Girl KN (6.1):** I think I’m really involved but sometimes, since I’m the programmer, I can’t do a lot. But basically all the time, we’re all involved in this stuff. When I am programming, I think I will be more involved in my work.

**Girl RK (6.2):** I think sometimes, we can get very off task and it can happen very easily. But overall, we’ve been able to get people on task and sometimes, you just have to give them a little push or ask them to do something to help out with it and they kind’ve remember what they’re supposed to do. But overall, we were involved and focused on what we were doing.

**Boy GB (6.3):** I feel that I’m focused and involved because I’m the leader and I have to help out and try and get people a job.
Boy UD (6.3): Well up until now since we don’t have our leader and I don’t have a big role as yet, I’m the programmer. So I try to be more involved by taking over the role of leader and just helping other people out when they need it. But when we start programming, it’s gonna be easier for me because I will have something to do and everyone else will have their own thing.

Boy BG (6.4): I think I’m a lot more on task than I was at the start. Like it was kind a hard to get into it at the very start of it, but then, as we start going into the actual design and plan the actual game, we started to get more into our roles (Mid-interview, April 2014).

One boy used an analogy to explain his level of involvement in the process. He commented,

I like looking at this like building a brand new airplane. There’s lots of trials and errors so you gotta figure it out. You make errors and then you got to go back to the storyboard and fix it, so that it keeps up to date on what you’re actually building and you know what’s going on (Mid-interview, April 2014).

Some students also commented on the ‘doability’ of their role-specific activities, which was also challenging and difficult at times:

Boy AB (6.1): I don’t think the project was difficult. I think the difficulty was at the beginning to collaborate with everyone and to work with everyone. I think that was the difficult part because you had to accept other people’s ideas and that probably wasted a lot of time for a lot of people. I think it’s extremely a completable task.

Girl SO (6.3): I felt it was difficult, but I felt it was a nice kind of challenge. It’s easily achievable if you can just have as much time as you’re gonna need (Mid-interview, April 2014).

Boy FM (6.2): At first I thought that we were going to just start drawing without a plan but then after a couple of classes that one of the key elements in this project was the planning. After we finished our idea stage we started on the storyboard that is very important. One challenge that came up was that after we got our app for drawing we thought it would be all fine but, we found out that after our first drawing when we went to colour it was too hard. Our solution to this problem was that after a little digging we found a colouring tool that fills the space that you
want it to. We are most proud of our backgrounds and our characters (Kidblogs, June 2014).

A few students, across classes, described their experiences as they lost track of time when they became so involved and focussed in their activities:

**Boy GC (6.1):** The time just seems to go by so fast. We just wanted to work and work and work on our storyboarding. It just seems, when you’re doing something fun, the time goes by really fast. But when you’re doing something not that fun, it seems to go by so slow.

**Boy MB (6.1):** We didn’t want the class to stop. We wanted to continue. There never was enough time.

**Girl ZJ (6.1):** We were lost in our fantasies.

**Girl PR (6.2):** We were all working so hard, our programmer was seeing what he could do and I was like writing the story and then it was like lunch time.

**Boy IE (6.2):** Well we kinda lost track of time cuz we were so into it. We were so into the storyboard. They’re saying time flies when you’re having fun and time snails when you’re doing something boring.

**Girl LR (6.3):** We were drawing our scenes in our storyboard, and it was like we just started!

**Boy BG (6.4):** Sometimes if it’s a good day, we can get so involved like we forget about the time. We feel like it goes by sooo fast (Mid-interview, April 2014).

However, about 17% of the students interviewed (mid-) explained that in their groups, they had difficulty experiencing that flow state in terms of being fully involved in their role-specific activities as much as they wanted to. Examples of reasons for this non involvement are captured in the following:

**Girl KN (6.3):** I’m usually a very focused person, but the thing is I’m the programmer so right now when we were working on the storyboard and right now the artist is working on the art and the leader is also helping with the art, and then the music person is working on the music, I feel like I have nothing to do. So I want to be focused, except I have no task to help because I’m not a very good artist. I want to help with the music, but I don’t think it will help very much. So it’s sort of hard for me
because I want to do something so it doesn’t seem that I am a freeloader, but I can’t do anything because there is no job for me to do right now.

**Boy SL (6.3):** I think our group has not been very involved. It’s like on and off. So once in a while, our group decides to work and people tell us to get working.

**Boy HY (6.4):** I’m the music person and every now and then there isn’t a job to do because I have to know the scenes to know what to make (Mid-interview, April 2014).

Some also commented that there were times during the tasks’ activities that they had also become bored. Two of the students indicated that they became bored due to the overwhelming nature of the storyboarding task, in particular. One commented, “I think that sometimes, I get a little bored like when we’re trying to make the storyboard and it doesn’t quite work and then we have to do it again and again. So it’s a little boring sometimes” (Mid-interview, April 2014). The other, “Making the storyboard was a long process, and that was also kind of boring because I don’t have a very long attention span” (Mid-interview, April 2014). Another student indicated that she became bored with her role. She commented, “The writing was kind of boring. I finished the writing in time but it was kind of boring” (Mid-interview, April 2014). Five other students, mostly boys, indicated that they became bored when reflecting in their blogs:

**Boy JY (6.2):** It’s kind of a rewrite. For each reflection that we did, it was kind of the same thing all the time.

**Boy LM (6.3):** I don’t really like writing what I just did, so it’s kind of a sum up of what I did in the last month and I just don’t really like doing that.

**Girl EF (6.3):** Since I was the writer, I had to do more writing and it became kinda boring. So it seemed like seriously more writing!

**Boy CV (6.4):** I don’t really like reflections, they’re not my favorite things to do and I’ve done so many. It was just kind of boring when we did a lot of reflections (Mid-interview, April 2014)
One student explained that she did not lose track of the time because she was not as involved as she wanted to be during the storyboarding task:

I’ve never really become super-involved that I lose track of time, but I guess I have some sort of fun. I don’t lose track of time because I’m not really working that hard because I don’t have that much to do even though I try to find things to do. I think I will be losing track of time when programming the game (Mid-interview, April 2014).

**Enjoyment**

Despite the few instances when they would go off task, lost interest, had difficulty collaborating in their groups and became demotivated, all the students/groups indicated that they had fun and enjoyed the project. Some of their responses, across classes, helped to explain that experience:

**Boy KE (6.1):** I find this project really fun because there is a different way to learn because you’re going to build a video game. You don’t just research and like put it into a Pages document. We actually get to build a video game.

**Girl FP (6.1):** I think it’s way more fun than actually listening to the teacher repeat and repeat and repeat to get it into your head and it’s fun and it’s a creative way that you can get kids to learn stuff.

**Girl ZJ (6.1):** It’s a lot more fun than just the teacher talking and just listening and taking notes.

**Girl PR (6.2):** We don’t have to like sit and learn. We have different jobs and we can learn from those jobs and as we put our game together, we can like learn a lot of stuff from creating the game because we can put all that knowledge into the game. We have more fun learning that way.

**Girl RK (6.2):** I think we’re having a lot of fun with the project. It’s definitely different than things we’ve done before. We don’t usually get to make games, especially in humanities, so it’s pretty cool.

**Boy UD (6.3):** I think it’s very fun because we each have our own job in the group and it’s much more exciting when we have our own responsibilities, so we be responsible for parts of the game. So I think it’s much funner
because you have something to do and it helps other people (Mid-interview, April 2014).

Boy SK (6.3): I felt it was a lot more fun instead of reading out of a textbook. We actually got to do something like hands-on and do something that we can relate to because I’m sure we all played video games before.

Boy MW (6.3): I personally don’t like reading words out of a textbook, so I found this was a lot more fun of a way to learn.

Boy TM (6.4): I felt that if I read about the decision-making process out of a textbook, it’s just kind of boring for me and I don’t have my full concentration on it. So I don’t always learn the best and sometimes I forget a lot of it. With this, it was more fun and more engaging, so I think I will remember more from it because it is so much more fun than reading out of a textbook.

Girl CW (6.4): I never really thought that this way of showing my understanding would be possible. But it was a lot of fun and I would do it again.

Boy AU (6.4): We didn’t have to deal with the textbook because it’s really painful to try and remember all those things. It’s just better to do something that I enjoyed doing. I think it was a really fun and engaging way to learn about the decision-making process and we will remember it a lot easier (Post interview, June 2014).

Students’/groups’ responses, across classes, also tended to indicate that the most fun was experienced in the storyboarding task:

Boy LT (6.1): I had the most fun doing the storyboard because it was fun creating the ideas and like getting to draw everything and like the whole group was collaborating, so it was not just one person doing all the work.

Boy TN (6.1): I found the storyboard the funnest just because with your group you can get fun ideas.

Girl HS (6.1): I had more fun storyboarding because of the drawings. They were funny, some of them, and we all like writing what was going to happen and stuff.

Boy JL (6.2): Making our storyboard was all kind of neat and engaging and fun because it was different to what we normally do. But I have to say when we all split into our individual jobs, it got a little bit tuffer but it was a little more fun because you actually got to do something on your own. For me that was the most exciting thing.
Boy UM (6.2): Our favorite part was when we had to storyboard it. Our group had a ton of fun like drawing all these characters.

Girl DF (6.3): I also think the storyboard was the most fun because the whole group got to collaborate and it was also more interesting because we got to see other people’s ideas, not just our ideas.

Boy JA (6.3): I had more fun storyboarding, too because we wanted to make our game like kind a fun and silly because that’s kind a our personalities so we drew some really wacky parts in our storyboard.

Boy AU (6.4): In our group making our storyboard was the funnest because we got to see all the flaws that we made and fix them and then put all the pieces together to make the game.

Girl CW (6.4): At the start, our group wasn’t really doing very well, like there was a lot of bickering between the members. So during the storyboarding I felt that everybody had kind of put all this aside and were actually getting something done. That was my most fun part (Post interview, June 2014).

Some, however, felt that they had more fun in the game concept development and programming tasks:

Boy OD (6.1): I found that kind of creating the game idea of what we were going to do was the funnest because we were all collaborating together and putting all our ideas. It was a really fun experience.

Boy RA (6.2): I found the game concept funner because it was kind of fun just running ideas pass each other and seeing which ones are good and which ones aren’t really that good.

Girl PC (6.2): For me, the game concept was the funnest because everybody was using ideas our group came up with and sometimes we laughed at our ideas because they were so over the top.

Boy UD (6.1): Well I really enjoyed actually making of the game as the programmer. I really liked programming and I thought programming and the making of the game was the most fun because it was quite easy.

Girl OR (6.3): I had most fun when I was making the game in Scratch. I think making the art during the programming was the funnest.

Boy SK (6.3): I feel like building the scripts was a very big part because you’re creating the game and you’re putting all of it together and you’re
actually finally getting to see how it’s gonna turn out and how’s it’s gonna be like. So, I find that, that was the most fun for me.

Boy UR (6.4): In the programming, sometimes I had to be doing things over and over and over again and that wasn’t as much fun as I had hoped. But when I actually got to programme and got a real dent in our project, I felt that was really great.

Boy TM (6.4): Programming the game and adding all the different characters and stuff like that was the funnest because not only did I draw the characters, I was adding them with the programmer to make the game (Post interview, June 2014).

Impact of the Design and Building of Digital Video Games on Students’ Development and Use of 21st Century Competencies

In this research study, the impact of digital video game design and building on students’ development of 21st century competencies, as they learned and applied their understanding of how the citizens in their various models participated in the government decision-making process was analyzed based on the following 21st century competency themes: critical thinking, problem solving and decision making, creativity and innovation, communication, information literacy, collaboration and teamwork, living in the world - citizenship, local and global and living in the world - life and career (Binkley, et al., 2010).

These themes are described in the Classroom Observation Protocol for Student Development of 21st Century Competencies (see Appendix F), and were used to guide researcher observation of students’ development and use of 21st century competencies as they participated in the learning tasks’ activities. Based on researcher observation, the 21st century competency themes seemed evident in all the learning tasks, but overall, they seemed most evident in the storyboarding and programming tasks and least evident in the game concept development task (as depicted in Figure 40). With the exception of problem solving and decision making,
development of all the 21\textsuperscript{st} century competencies seemed to be evident as the process continued from game concept development to storyboarding and programming, with some drawback in communication and collaboration and teamwork during the programming task.

\textit{Figure 40.} Radar graph showing evidence of 21\textsuperscript{st} century competencies in the game concept development, storyboarding and programming tasks

More specifically, in the game concept development task, (as also depicted in Figure 41), the data seemed to indicate that throughout the task, problem solving and decision making were evident in all 14 sessions, compared to critical thinking which was evident in 10 of 14 sessions, creativity and innovation and information literacy in 8 of the 14 sessions, communication, collaboration and teamwork and living in the world - life and career in 6 of the 14 sessions, while living in the world - citizenship, local and global was somewhat evident.
In the storyboarding task, (as also depicted in Figure 42), the data seemed to indicate that throughout the task, all the competencies were evident in all 18 sessions. In the programming task, (as also depicted in Figure 43), the data seemed to indicate that throughout the task, all the competencies were evident in all 42 sessions, with the exception of communication and collaboration and teamwork which were evident in 34 of the 42 sessions.
To probe further into these findings, I used the mid- and post interviews with teacher participants and groups of six students (at least one member from each group) in each grade 6 class, and excerpts from all the students’ Kidblogs and teachers’ documents. This helped to substantiate my observations and to provide further evidence of the ways in which students’/groups’ design and building of their video games seemed to impact their development and use of 21st century competencies, while participating in the learning tasks’ activities. The teacher participants explained that their adoption and implementation of the video game design and building process to teach social studies was an effort to ensure that their students continued to develop and use 21st century competencies as part of their learning experiences. Matt commented that

this process fits nicely with 21st century competencies. These competencies represented 80% of this element/unit. When we decided we were going to go forth with this unit, we wanted to make sure these things are embedded in the process. It wasn’t simply let’s get
7 facts and let’s make a game. In the hands of a teacher who has sound pedagogical
techniques, using this video game concept is a nice way of communicating these
capabilities (Mid-interview, April 2014).

To reiterate, Dave added,

The whole project is all of those competencies. They collaborate, they’re creative, they’re being innovative and they have to synthesize a whole lot of information into something that’s useful for them. This project is a chance to really articulate them a little bit more (Mid-interview, April 2014).

Based on their responses in the mid- and post interviews, most of the students/groups seemed to support their teachers’ views that the process helped them to become even more proficient and skilled in their use of 21st century competencies, more particularly, problem solving, decision making, critical thinking, creativity, collaboration/teamwork, communication, information literacy and preparing for their future as they developed skills to participate in the real world context.

**Problem Solving**

As students/groups actively participated in the activities in each learning task and attempted to communicate their understanding of how the citizens in their various models participated in the government decision-making process, they also needed to solve various problems that emerged and could have inhibited their progress within the process. One of these main problems was students’ collaboration within their groups. According to Dave, “Some groups did not work as well as other groups because of personality conflicts and working in a group with people that may not be [their] friends on a project that is not a one-off or for almost a year” (Mid-interview, April 2014). The teacher participants explained that they attempted to address this problem by using their co-constructed *Let’s Reflect* rubric to allow students/group
members to self and peer reflect on their performance and progress within the group and to suggest ways for improvement (as described in Chapter 4).

However, based on researcher observation and as pointed out by teacher participants during our planning meetings, there were problems that students/groups attempted to solve without teacher assistance by using their own initiative and a variety of resources. Two of these problems included performing their specific roles during the storyboarding task and communicating during the programming task because of the distance between the programmers and their group members (as described in Chapter 4). Teacher participants commented that in their attempts to solve these problems, students’/groups’ development and use of their problem solving skills became even more apparent. In our conversations during the interviews (mid- and post), students’/groups’ described how they addressed their role-specific and communication (due to distance) problems without the assistance of their teachers. The following responses/comments from some of the students, across classes, described the nature of their role-specific problems and how they were addressed:

**Boy WP (6.1):** So like it’s not rocket science. It’s like when you have a certain specialty, you have to like use it in the group, so that you can use your specialty to help out the group as much as possible.

**Boy OD (6.1):** I think that if we didn’t change our roles, the process would have been much slower.

**Girl PC (6.2):** Our leader didn’t really have anything to do because our programmer was in the library programming and we were all working on our own getting our roles done. So, she really didn’t have anything to do, so she became kind a like second musician to help our musician out.

**Boy JL (6.2):** The story writer finished our story really fast and our musician completed everything and our leader and story writer just helped our artist to create the art. Without the story writer and leader switching to the artist role, we would have been really behind on our art.
Boy JA (6.3): I was the musician, and I sought of became the artist because we were like behind on our art and we needed a lot more.

Girl OR (6.3): We finished the story writing really quickly and our story writer and leader didn’t have much to do, so then they became artists. We needed a lot of art so we had 3 artists, 1 musician and I was the programmer.

Boy CU (6.4): Well, actually, I was the initial programmer for my group, but our musician really liked the idea of programming, so, we kind of switched roles (Post interview, June 2014).

One student, however, indicated that in addressing their role-specific problems, her group did not need to switch roles:

We didn’t really switch roles. We just helped each other so that got the work done a little faster. Everyone helped with each other’s jobs. In our group, what we did, we all just sat down and we all just went and we brainstormed all together and then after we had gotten a very rough idea, the story writer kind of went through it and finalized it. So that’s how we did our jobs for our game (Post interview, June 2014).

In addressing the communication (due to distance) problem, students explained that each member based on his/her role, would join the programmer in the library and assist the programmer in the capacity of his/her role, as programmers coded and scripted the games. For instance, the artist would work with the programmer in drawing and coding the artwork, and so on. Some students described how they used technologies and group members to address that distance gap:

Girl PC (6.2): Some groups used FaceTime and some groups didn’t, but whatever we were using, no matter what the situation is, when the programmer is up in the library programming and recording the stuff on the project, we always had to keep in touch with our programmer just to make sure that she was adding new concepts to the game.

Boy UM (6.2): We used iMessages and FaceTime but we mostly used a runner [one of the group members]. Like everybody downstairs would tell their stuff to the runner and he’d tell us. We did use FaceTime but it wasn’t very
effective because we kept losing our Internet connection. So we used iMessages and the runner.

**Girl CW (6.4):** With FaceTime, it was also difficult to hear the person because of all the noise in the background and everything because there were so many other kids, and also it’s a library so you need to kind of keep quiet, so it was hard. So we used iMessages. That’s another app where you can type a message and send it to our group downstairs – texting (Post interview, June 2014).

**Decision Making**

Students/groups also indicated that their participation in this project helped to further develop their decision-making skills within their groups:

**Girl EC (6.1):** It helped us figure out how we had to make decisions. Like when we had to make decisions about which topic we would choose for our game, should it be the Iroquois or Ancient Athens. And then we kind a had to decide what we wanted to do for our game because we had different ideas.

**Girl HS (6.1):** I think it helped me a lot in decision making because it kind a like gave us a lot of knowledge and information about how you can make different good decisions.

**Girl DB (6.2):** We did a voting kind of thing with our questions and then one person would choose those we could go with. Then we would think of a different thing and that really helped us piggy back on each other’s ideas and make them better and then at the end everybody agreed on the same thing, so.

**Boy JL (6.2):** So we learned about decision making, consensus, majority rules, basically all that. In our group when we were deciding on our ideas, we would go with the majority. We were practicing what we were learning.

**Girl PC (6.2):** Now we basically understand how some other people make decisions. We definitely put way more thought into it now.

**Boy UM (6.2):** It’s not only like you’re trying to educate people through a video game. It’s also like the decision-making processes within the group, in general. So it’s kind of with two different structures (Post interview, June 2014).
Creativity and Innovation

Students/groups, across classes, indicated that their participation in this project also helped to further develop their creative and innovative skills (e.g., demonstrating initiative, imagination, developing, implementing and communicating new ideas to others effectively, working creatively with others, willing to take risks, resiliency and perseverance when faced with obstacles and challenges), particularly in the storyboarding and programming tasks. Their use of various technologies also seemed to enable these skills:

Boy WP (6.1): Well, making a game, it doesn’t just come. You really got to think and as a group you got to think of what you want the game to be about and how’s it gonna look. There’re a lot of questions that need to be asked and answered and people have different ideas and we have to want to compromise between them. So yeah, we were creative that way.

Girl DB (6.2): We probably learned more creatively while doing the storyboard because we had research, but we were creating it. We were not just inserting a presentation. We had to think of a game idea and we had to think how we gonna create our game and how it’s gonna be.

Boy UM (6.2): Scratch was new to me. I didn’t even know it existed. So, it was a new program that was effective for making our games. There was a lot of other new programs we used, not just Scratch. We found a pixel app that we used to turn pictures into pixels.

Boy SK (6.3): I think all our creativity was shown here because in the group, our artist drew cool characters and I programmed cool stuff and the story writer storyboarded us.

Girl DF (6.3): Instead of throwing information into a presentation and making it look nice, you have to incorporate, you know, put in the information to make it fit well in the game. So, that is more a creative way to present information than just putting it in a presentation and throwing it out there.

Girl OW (6.4): The creativity I think we developed most in this project was scripting.

Girl CW (6.4): It’s just like the egg analogy. If it just fell on the cushion, nothing will spill out. It’s just okay, you got the basics done, you good to go, next unit. Whereas with this project, you throwing it on concrete and everything spills out, so everyone knows that we know what we’re
talking about and they’re going to know what they can talk about as soon as they understand.

**Boy TM (6.4):** And because this is a project no one’s done before, you kinda just chucking that egg and waiting. Is it going to be a cushion, or is it going to be the ground? And if it’s the ground, it may splat everywhere and blow everyone’s minds and everyone will come and see it again or if it’s a cushion, it could just be a dud (Post interview, June 2014).

**Critical Thinking**

Based on researcher observation, critical thinking seemed to be one of the 21st century competencies that was most promoted by the teacher participants, particularly in the game concept development and storyboarding tasks. Dave explained that although they usually placed a lot of emphasis on critical thinking in teaching social studies, because they did not know what the end product in this game design project would be, they needed to “really encourage [students] to think critically to get that feedback [from them] to find out what their ideas could potentially look like” (Mid-interview, April 2014). He also stated that they promoted critical thinking to help shape students’/groups’ ideas “to be as effective as they needed to be” (Mid-interview, April 2014) in order for them to communicate their deep understanding of how the citizens in their various models participated in the government decision-making process.

**Collaboration/Teamwork and Communication**

All the students indicated that because of the nature of the tasks’ activities and the amount of time needed to complete these activities, they learned how to collaborate and work in teams. This also helped them to improve their collaborative and communicative skills (e.g., building respectful, caring and effective relationships to manage conflict and differences and to seek consensus in the pursuit of common goals, demonstrating the ability to interact respectfully with others and sharing responsibility as team members) as they got to know each other better, especially in the storyboarding task:
Girl ZJ (6.1): I learned collaboration skills. The reflections with our group kind of helped us realize what we needed to do and what is good with our collaboration skills or what we need to change.

Boy MB (6.1): Since you have to work with each other for such a long time instead of just for a week, I think it helped our group come along together and to be able to cooperate a lot better than in the beginning.

Boy GT (6.1): I learned not only to contribute ideas, but also to improve others’ ideas or to help them speak, which I was not very good at before this project.

Boy CH (6.2): That’s a no-brainer! Some of the students that don’t usually talk much, now they are talking a little more and we are actually having more fun than we had before. We are working with students we never worked with before and we’re getting closer.

Girl KE (6.2): We have different talents in the group, like I know K does not talk very much so we help her. But she can draw very well and she contributes to the group in that way.

Girl PR (6.2): We got to know each other better. I was pretty shy in my group because I only knew D and I never really talked to the boys except A and B, so I think I got to know everyone in my group better.

Boy BL (6.2): I just want to say one of the other big things that we’re learning here is group work because it’s not exactly easy to work with a group all the time and for this it’s a bit more so that way (Mid-interview, April 2014).

Girl DF (6.3): I learned to work with different people because I’ve never really worked with my classmates in a group before, and I thought it was cool to learn what their interests were and I just learned more about them.

Boy SK (6.3): I learned team work a whole lot because as soon as one person tried to take over, everything would fall apart.

Boy JA (6.3): I think it’s better that we’re learning in a group because it teaches you group work, because I know that it’s a lot harder when you don’t have the perfect group mates. So it teaches you group work to work with what you get. You realise that there are times when other people go off task and when you go off task, it teaches group work to get back on task.

Girl YS (6.3): It’s like a team so think of it as a sports team. So you’re a striker, forwards, mid-field, defence and stopper and you all have to work
together to score that goal and win that game. For us, that’s the same with us because we wanted to create a game, finish the game and make it good.

**Girl OR (6.3):** I never had to debate before. We just all sort of worked together in different groups. But in this project, I sort of realise I needed to communicate and collaborate at a deeper level because I’m trying to work with my group because it’s a more challenging group for me for some reason. But I learned more about collaboration and if this happen again, I would know what to do now to get my group working better.

**Boy UR (6.4):** I think the group work has really helped improved our communication. But at the start, basically, when we state our ideas, they could not understand and took it the wrong way. Now we are closer as a group.

**Boy TM (6.4):** The group work actually helped us to communicate better and now, we will be able to communicate better with anyone we get to work with (Post interview, June 2014).

Students from two of the groups indicated that because of the activities, they collaborated and communicated with their teachers even more, particularly in the game concept and storyboarding tasks:

**Boy WP (6.1):** I feel that now we’ve been working on the project for a while, our teacher made more presentations that say what we have to do today. So I think that’s a bit better with our communication than just ‘here, go do that today’.

**Boy JL (6.2):** I think he kind a sees that if we are debating with him, he takes what we have to say into consideration and he tries to help us out with ‘yes that’s right, no, that’s not, and kind a gives us more ideas and that kind a helps us work better together (Post interview, June 2014).

Two students, however, indicated that there did not seem to be any increase in the collaboration and communication with their teachers as they worked in this project:

**Girl CW (6.4):** I think we haven’t worked with our teacher that much in this project because our group is deciding all the things. We can go whichever way we want. We can choose what kind of democracy we want to study.

**Boy VN (6.1):** I didn’t think that it was a decrease or an increase at all. It’s just about the same (Post interview, June 2014).
Information Literacy

All students indicated that as they researched the content for their storylines, searched and downloaded apps to help them create the artwork and music in their storyboards and reviewed coding and scripting examples in other Scratch projects to inform their deep learning of game design principles, coding/programming and scripting knowledge and skills and the Scratch software, they collaboratively made extensive use of online search engines. They also indicated that working on this project also gave them access to various resources, such as the kidblogs, which they used for reflections and knowledge building tools, such as Google documents in which they developed their game concepts and designed and created their storyboards. This experience allowed them to access, understand and manipulate digital information creatively and effectively in ways that they had never used before.

Living in the World

Students, across classes, also indicated that as they participated in the project, particularly in the storyboarding and programming tasks, they seemed to develop skills that would prepare them for their future lives and careers (e.g., participating in learning community activities, helping to solve problems affecting the local learning community, operating in varied roles, responsibilities, demonstrating integrity and ethical behavior in using influence and power):

Boy AM (6.1): I learned to be a better leader because I had to make sure that everybody was on task and that if anybody needed help, we would help them and to make sure we worked as a team to get stuff done.

Girl PC (6.2): I learned the skill of patience. You do have to wait a lot and be patient when the programmer will need you to do anything. It just made me more patient.

Girl OR (6.3): Something I also learned was sort of how to be patient because I understood patience but not really being patient. Being the programmer, the artist did not have much of our drawings done and I only had just a little bit to work with and I was super frustrated. But I
understood how hard things can get because I didn’t know how hard it was for them also.

**Girl MG (6.3):** I think team work would probably help me the most because team work is included in many places and it is easier to work with a team than to work alone. Some things you can’t just do alone. At first it was very frustrating working with my team. That actually made it help because like say in the future if I was to ever work in that sort of tense team again where from the start it’s constant bickering and then getting mad at each other, then I would know that oh this has happened to me before and I would know how to almost solve this.

**Girl OW (6.4):** I actually believe I learned more about my social skills and getting out into the Scratch community; there’s a whole community. There’s like studios and projects and all sorts of things and then I opened an account and actually made a ton of online friends and stuff and I found it was something I was enjoying to go home and do it on my own time (Post interview, June 2014).

**Impact of the Design and Building of Digital Video Games on the Interconnection**

**Between Deep Learning, Intellectual Engagement and 21st Century Competencies**

In carrying out this analysis on the impact of video game design and building on students’ deep learning of the chosen curriculum, intellectual engagement, and development and use of 21st century competencies, there also seemed to be some indication that the learning tasks’ activities allowed for that interconnection or interplay between deep learning, intellectual engagement and/or development and use of 21st century competencies. For instance, how they seemed to be mutually entwined can be captured in some of the responses provided by students/groups during the post interview and in their Kidblogs, while describing their experiences:

**Boy GT (6.1):** As well as learning about how the Athens’ democracy style was, we also got to learn how to improve our group work skills and we also got to learn how to use Scratch.

**Boy WP (6.1):** It helped me, at least, really have a deeper understanding of the decision-making process because we just had to do more and we wanted to do more research because video games are fun.
Boy UM (6.2): I think we did learn the information that we already know at a deeper level definitely because we got to use it and I’m sure we all will remember now because I used it somewhere where I enjoyed it. It was fun making and I only remember stuff if they’re interesting facts and stuff and as soon as I made a game out of it, it was a lot of fun and it was really interesting. And we didn’t only learn about democracy, we also learned how some movies are storyboarded, how games are storyboarded, how games are built, how to programme and it was a lot of fun going through the process.

Boy RA (6.2): If one person doesn’t really understand, everyone will help them and then everyone gets pushed upwards. And then if there is one person that for some reason gets it way better than everyone else, they can teach everyone that, so we learn much better and we learn more.

Girl DB (6.2): I actually did feel that I was learning a lot more about my topic and it did make me deepen my learning skills and it was fun. When I do grow up, I probably will remember this the most because this is a new thing. We’ve never done it before.

Boy JA (6.3): It made it easier to learn and understand what we were learning because we were researching and using our ideas in a fun way (Post interview, June 2014).

Girl SN (6.2): I have really enjoyed the scratch project and I can’t believe we went from nothing to a video game that we all had a part in creating. This project helped me understand all about decision making in Ancient Athens. My group had troubles along the way, but we all came together in the end and made a great video game that hopefully somebody will play. I bet any other school would just read a textbook but I thought it was very unique to create a video game. In the end it was a great project and I learned lots! (Kidblogs, June 2014).

Further examples of this interconnection can be captured in the following video snippets made during the group share activities:

https://www.youtube.com/watch?v=7LVspDjOP1U&feature=youtu.be;

https://www.youtube.com/watch?v=QuRrFGQ8f1I&feature=youtu.be

As you access these video snippets, watch and listen to this interplay of deep learning (knowledge creation, disciplined inquiry, critical thinking, higher order thinking, student-student collaborative discourse, communication, active learning, formative assessment, self
assessment/peer assessment and feedback), intellectual engagement (flow, motivation, effort, enjoyment, interest and relevance) and 21st century competencies (critical thinking, problem solving and decision making, creativity and innovation, communication, information literacy, collaboration and teamwork).

Based on this observation, some of the questions that seemed to emerge about this relationship were as follows:

1. Is learning more meaningful when deep learning, intellectual engagement and 21st century competencies are at play at the same time?

2. Together, do they encourage that ‘messiness’ of the learning environment that motivates students to inquire or question, discover, take risks, fail and learn from that failure what they may not have otherwise learned?

3. Do they provide the missing ingredients for that innovativeness in responsive pedagogical designs needed for technology-enhanced teaching and learning environments?

This extensive analysis of the data attempted to address the questions that guided this research study and in the next Chapter (6), I discuss these findings by (i) assessing/evaluating the effectiveness or the extent to which the design and building of digital video games, implemented in this study, functioned as an innovative pedagogy that could also address the problem that initiated this research study and (ii) showing how the design and building of digital video games, as implemented in this study, addressed some of the concerns and/or gaps identified in past research studies on the pedagogical usability of digital video game design and building in school.
Chapter 6: Discussion of Findings

Introduction

This chapter represents the final phase of the DBR process. Its purpose is to assess/evaluate and reflect on (i) the potential and effectiveness of the intervention/the design and building of digital video games, implemented and explored in this research study, as an innovative pedagogy that could intellectually engage students in deep learning of curriculum content and promote their development and use of 21st century competencies, thus attempting to address the problem that initiated this study; and (ii) its effectiveness in possibly addressing some of the concerns/unplanned effects and gaps identified in past research studies, in and beyond the school context.

This assessment/evaluation and reflection will inform a discussion of the findings that resulted from an analysis of the data that was collected during the implementation and exploration of the intervention in the prototyping phase of the DBR process. As such, I present this discussion in two sections: (i) I assess/evaluate and reflect on the potential and effectiveness or the extent to which the design and building of digital video games functioned as an innovative pedagogy, more specifically, an innovative pedagogy for deep learning that could also involve intellectual engagement and development of 21st century competencies; (ii) I compare the findings on the pedagogical usability of the design and building of digital video games, in this study, with findings from past research studies, in order to discover how similar or unique the outcomes and experiences were and to show how the intervention, as implemented in this present research study, may have possibly addressed some of the concerns/unplanned effects and gaps identified in past research studies in and beyond the school context.
The Design and Building of Digital Video Games as an Innovative Pedagogy

In describing innovative or new pedagogies for deep learning, Fullan and Langworthy (2014) explain that these pedagogies leverage and are mainly concerned with:

- deep learning, defined as creating and using new knowledge in the world that goes beyond the mastery of existing content knowledge assisted by technologies;
- shifts in teaching that focus on the learning process in developing students’ ability to lead their own learning and to do things with their learning rather than on covering all required curriculum content;
- partnerships between teachers and their students in “deep learning tasks characterised by exploration, connectedness and broader, real-world purposes” (p. 7);
- learning outcomes that are measured in terms of “students’ 1) capacities to build new knowledge and to lead their own learning effectively, 2) proactive dispositions and their abilities to persevere through challenges, and 3) the development of citizens who are life-long learners” (p. 7).

To meet these requirements, Fullan and Langworthy (2014) identified three core components of these new pedagogies: (1) new learning partnerships; (2) deep learning tasks; and (3) access to digital tools and resources. They also make use of the dimensions of an initial model, a Continuum of New Pedagogies Effectiveness (see Figure 44), to analyse the effectiveness of new pedagogies in practice. In the discussion that follows, these core components and the Continuum of New Pedagogies Effectiveness will be used as a framework to assess/evaluate and reflect on the potential and effectiveness of the design and building of digital video games as an innovative pedagogy, more specifically for deep learning that could also
involve intellectual engagement and development of 21\textsuperscript{st} century competencies, based on the findings of this present DBR study.

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{Figure44.png}
\caption{Fullan and Langworthy’s (2014) Continuum of New Pedagogies Effectiveness}
\end{figure}

**New Learning Partnerships in the Design and Building of Digital Video Games**

According to Fullan and Langworthy (2014), “learning partnerships are the relational context in which the most powerful strategies of the new pedagogies find their home” (p. 12) and as new pedagogical partnerships, represent “one entry point into rich seams of deep learning” (p. 20). They further state that these learning partnerships “emerge from a set of roles for both teachers and students different to the ones found in many classrooms in the world today” (p. 12).

Four of these emergent roles in the new learning partnerships include relationships, feedback, student aspirations and learning to learn and peer tutoring, which Fullan and Langworthy (2014) described as “essential in the new pedagogies because they set the context in
which teachers can more deeply know their individual students and, through that, analyse student progress to understand which teaching and learning strategies best activate an individual student’s learning” (p. 19). As a first step towards assessing/evaluating the design and building of digital video games as an innovative pedagogy for deep learning, these emergent roles are used to discuss the new learning partnerships in that process.

**Relationships.** In discussing the first of these roles, relationships, Fullan and Langworthy (2014) explain that human relationships in the new pedagogies become more central to the learning experience and are not limited to just a few minutes before or after classes. Instead, the entire learning experience is deeply rooted in the relationships that exist between teachers and their students, student peers, students and their families and within social networks that connect those with similar learning interests and aspirations.

In this research study, the learning partnerships or interaction between teachers and their students/groups, student/group peers and teacher peers were central to the learning tasks (game concept development, storyboarding and programming), implemented in the prototyping phase of the DBR process, where most of the learning took place. These learning partnerships may be located in the middle stage or stage of development of the pedagogical component of Fullan and Langworthy’s (2014) Continuum of New Pedagogies Effectiveness (see Figure 45). A description of these learning partnerships, as they contributed to the deep learning experience, follows.

![Figure 45. Location of learning partnerships in all the learning tasks in the pedagogy component of Fullan and Langworthy’s (2014) Continuum of New Pedagogies Effectiveness](image.png)
**Teacher-student learning partnership.** As teachers implemented the game concept development and storyboarding tasks in the prototyping phase of the process, they indicated that they needed to be very involved in shaping and co-constructing ideas with the students/groups and each other in their effort to mainly promote a deep learning of the curriculum content, exemplified in students’/groups’ deep understanding of how the citizens in their various models participated in the government decision-making process. As explained by one of the teachers, they did not want to see groups creating games that did not honor how much they know in their learning of the chosen curriculum content.

Therefore, teacher-student and teacher-group interactions became more extensive in the implementation of the tasks, especially in the game concept development and storyboarding tasks, to solidify/strengthen that teacher-student learning partnership. This relationship building was mainly encouraged through more extensive and frequent discourse/communication and collaboration.

As students/groups participated in the programming task, this teacher-student learning partnership changed when teachers took a more hands-off approach, allowing for more student-led/centred learning to emerge. The teacher-student learning partnership was mostly with group members other than the programmers to facilitate the continued modification of the necessary information and assistance to be provided to the programmers as they built the game prototypes. This modified teacher-student learning partnership tended to advance students along their learning paths, while helping them to think more clearly about their contributions to the learning goals and how well they were doing in achieving these goals, leading them to become more autonomous learners (Fullan & Langworthy, 2014). As a result, this learning partnership in the programming task can be placed in the advanced stage of the pedagogical component of Fullan and Langworthy’s (2014) Continuum of New Pedagogies Effectiveness (see Figure 46).
Peer learning partnership. As students participated and were actively engaged in all the learning tasks’ activities, peer learning partnerships through student-student, student-group and group-group learning, became more evident. This partnership encouraged students’/groups’ creation or development of new ideas or knowledge to communicate their deep understanding of how the citizens in their various models participated in the government decision-making process. It also provided opportunities for teachers to learn more about the progress of each group and to offer suggestions for next steps. As with the teacher-student learning partnership, this peer learning partnership was mainly encouraged through frequent discourse/communication, collaboration within groups and peer assessments (group-share reflections across groups and peer assessments within groups to inform the actual building of the game prototypes). Observations of peer learning partnerships in this study reflect McGlynn’s (2004) claim that learning in groups does promote deep learning and help to form supportive relationships among group members.

Teacher-teacher learning partnership. As the two teachers planned and implemented the game concept development, storyboarding and programming tasks, they also collaborated more intensely because, as one of the teachers stated, the process was progressively challenging, and the other indicated that doing this on their own would have been very difficult and frustrating. This collaboration resulted in an intense partnership between the two teachers as they designed their instruction and implemented the learning tasks. This teacher-teacher learning partnership...
partnership seemed to encourage more engaged and collaborative teaching and teachers as activators and designers of learning (Daniels, Friesen, Jacobsen & Varnhagen, 2010; Friesen, 2009; Hattie, 2009; Kalantzis & Cope, 2010; Weaver & Wilding, 2013).

**Teacher and student roles.** These partnerships emerged from a set of roles for both teachers and students that are different to the ones found in many classrooms in the world today (Fullan & Langworthy, 2014).

*Teachers’ roles.* As stated by Fullan and Langworthy (2014), in the new pedagogies, “the teacher takes a highly proactive role in driving the learning process forward. . . teachers do not have less of a role; they have a new active role, more engaged with students and other teachers than ever before” (p. 20). In their initial planning of the learning tasks’ activities, the two teachers, in this research study, saw their roles as mainly curriculum content experts, facilitators, instructors and assessors. However, other roles seemed to emerge for the teachers as they implemented the learning tasks, which greatly enhanced their teacher-student/group and teacher-teacher learning partnerships. For instance, the teachers also assumed roles as activators and designers of student learning, collaborators, learning coaches, reviewers and models in their pedagogical capacity while they used various strategies. More specifically, in these roles, the teachers tended to:

- build and promote trusting relationships with their students and each other;
- help students find and build on their interests and aspirations through the tasks’ activities;
- provide high-quality and constructive feedback and encouragement to students, especially when they faced challenges as they participated in the learning tasks’ activities;
- collaborate with each other and leaders (e.g., professional development leader, principal and vice principal) in contributing towards the impact of the various learning strategies on students;
- model a proactive disposition towards learning as they worked with their students to create new knowledge (curriculum content through stories, art, music, game prototypes) and to promote students’ deep understanding of that knowledge through their role-specific skills;
- continuously provide and encourage students to use digital learning tools and resources to help them explore new information and ideas to create their games, challenge them to create and communicate their new knowledge, connect with their peers and experts (other teachers, professional development leader, principal, vice principal and visiting business professionals) beyond the classroom and assess and share information on their learning abilities and progress (Fullan & Langworthy, 2014).

*Students’ roles.* Contrary to the ways in which the teachers would group their students to work on projects, in this research study, students began their participation in the learning tasks’ activities with assigned roles, such as leaders, story writers, artists, musicians/sound engineers and programmers (as described in Chapter 4). However, with their continued participation in the tasks’ activities, the students seemed to assume other roles (as listed and described in Table 22), which in addition to their assigned roles, seemed to greatly enhance their peer learning partnership and greatly encouraged more intensive group work, which the teachers stated was necessary to meet the learning and intervention goals as students/groups designed and built their video games.
Table 22

Emerged Students’ Roles During Their Participation in Learning Tasks’ Activities

<table>
<thead>
<tr>
<th>Students’ Roles</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Historians</td>
<td>Students had learning opportunities to become history experts while researching and learning about Ancient Athens and Iroquois confederacy.</td>
</tr>
<tr>
<td>Inventors and designers</td>
<td>Students became designers and builders of new and authentic digital video games; continuously discovered and created digital learning tools and resources to explore new information and ideas (art and music apps); used these tools to create new knowledge and to connect with peers and experts; designers of their own learning.</td>
</tr>
<tr>
<td>Problem-solvers</td>
<td>Students learned to take on complex challenges and work with peers and teachers to produce original and authentic products/artifacts; developed capacity for reflection and perseverance in the face of challenges.</td>
</tr>
<tr>
<td>Project-managers</td>
<td>Students conducted and participated in this authentic, rigorous project-based learning project in their classrooms.</td>
</tr>
<tr>
<td>Collaborators</td>
<td>Students collaborated using tools like Google Drive, Edmodo, game software, Scratch and new apps/technologies to design and communicate their deep understanding of how the citizens in their various models participated in the government decision-making process; built trusted relationships with teachers and peers.</td>
</tr>
<tr>
<td>Debaters</td>
<td>Students were given opportunities to practice discourse and defend their ideas as they developed their game concepts and storyboards.</td>
</tr>
<tr>
<td>Apprentices</td>
<td>Students were given the opportunity to learn by doing something they were greatly interested in and love; explored own interests and aspirations in learning goals and tasks.</td>
</tr>
<tr>
<td>Gamers</td>
<td>Students designed and developed/built prototypes of video games to solve given problem.</td>
</tr>
<tr>
<td>Learning coaches</td>
<td>Students worked/engaged with peers/classmates/learning coaches as a natural part of their learning environment; reciprocal teaching and learning from and with peers and teachers.</td>
</tr>
<tr>
<td>Reviewers/assessors</td>
<td>Students reviewed/assessed peers’ work and provided constructive feedback for improvement and completion of tasks’ activities; provided feedback to teachers and peers on what was working in their own and group learning.</td>
</tr>
<tr>
<td>Teachers</td>
<td>Students became teachers as they taught their teachers and peers how to use some of their newly discovered technologies.</td>
</tr>
</tbody>
</table>

*Adapted from VanderArk & Schneider (2012) and Fullan and Langworthy (2014)*
Feedback. Fullan and Langworthy (2014) also stipulate that the new learning partnerships, which are at the heart of the new pedagogies for deep learning, also “generate a strong foundation for both teachers and students to provide highly effective feedback in the learning process” (p. 16). Supported by research on the importance of timely and constructive feedback to effective student learning (Hattie, 2009; Hattie & Timperley, 2007), Fullan and Langworthy (2014) further explain that getting the ‘right kind’ of feedback is not only essential for promoting learning progress, but also for contributing towards the development of those skills needed by students to cope with challenges encountered during the learning process.

During the implementation of all three learning tasks, findings indicated that throughout the learning tasks, the use of feedback loops was prominent in driving and iterating the tasks’ activities and students’/groups’ progress and eventual achievements. Teachers and students, especially, used and provided constructive feedback to develop a common understanding of what learning progress looked like and actively engaged in evaluating that progress, by adjusting and refining their work.

For instance, students’ self-assessments (Let’s Reflect and elevator pitches) (see Appendices N and T) provided teachers and students with feedback on how individual students cooperated, contributed, communicated and collaborated, as well as addressed the conflicts that were evident within their groups and on each student’s perspective on the strengths and/or weaknesses of the design and content of their storyboards. Students/groups used teacher feedback from the instructional conversations, discussions, Socratic dialogues/questioning and coaching and scaffolding sessions, for example, to improve on their work until they achieved the success criteria for each task, symbolized by a green light (as described in Chapter 4). The summative assessment provided both teachers and students with feedback on students’
contributions to the successful continuation and completion of each task, through their roles, or how well they performed in the whole learning process.

Students also explained that the feedback received from their teachers was critical to their deep understanding of how the citizens in their various models participated in the government decision-making process, their game aspects or game design principles and role-specific activities, especially during the creation of their storyboards. Some students also indicated that the feedback provided from their peers was also invaluable to their learning. Contrary to Robertson’s (2012) report that the practice of taking the advice from peer reviewers to improve their games is more evident in girls than boys, in this DBR study, it was observed to be equally evident in both girls and boys.

**Student aspirations.** “Connecting learning to students’ real lives and aspirations is often what makes the new pedagogies so engaging for students” (Fullan & Langworthy, 2014, p. 15). Students’ participation in the learning tasks’ activities allowed for that type of connection through their assigned roles using various technologies. In describing some of their aspirations as learners, almost all the students described themselves as ‘hands-on and engaging learners’ who prefer to learn with technology and through projects (Pre-interview, October 2014). The learning tasks allowed them that hands-on experience (as described in Chapters 4 and 5).

As students participated in the tasks’ activities, particularly in the storyboarding and programming tasks, they also seemed to develop skills that would prepare them for their future lives and careers (e.g., participating in learning community activities, helping to solve problems affecting the local learning community, operating in varied roles, responsibilities, demonstrating integrity and ethical behavior in using influence and power) (Chapter 5).

**Learning to learn.** Fullan and Langworthy (2014) claim that “learning to learn, where students become meta-cognitive observers of their own and others’ learning processes, is a
fundamental goal in the new pedagogies” (p. 17). They further specify that in learning to learn “students begin to define their own learning goals and success criteria; monitor their own learning; critically examine their own work; incorporate feedback from peers, teachers” (p. 17).

This learning to learn concept was evident throughout the learning tasks’ activities in this study as teachers provided opportunities for all the students to mostly monitor their own learning and to critically examine their work and progress through self and peer assessments (e.g., elevator pitches and group-share reflections), through reflections in their kidblogs and by defending their ideas in discussions with their teachers and peers. As discussed earlier, the students used the feedback from these assessments, reflections, discussions and instructional conversations to evaluate their work and their progress and to modify where necessary, to make improvements, which led to a “deepen[ed] awareness of how they function[ed] in the learning process” as they tried to meet the learning goals (p. 17).

Based on the discussion in this section, learning partnerships seem to be a component of the learning tasks, which represent the actual design and building of students’/groups’ video games and located in at least the development stage of the Continuum of New Pedagogies Effectiveness. This begins to demonstrate the potential and effectiveness of the design and building of digital video games in meeting the requirements of new pedagogies for deep learning.

**Deep Learning Tasks in the Design and Building of Digital Video Games**

Deep learning tasks, the second core component of the new pedagogies, according to Fullan and Langworthy (2014) “harness the power of the new learning partnerships to engage students in practicing the process of deep learning through discovering and mastering existing knowledge and then creating and using new knowledge in the world” (p. 21). They further stipulate that
it is through deep learning tasks that students in the new pedagogies gain experience in developing their aspirations, in taking the initiative to learn, in learning to persevere through tough challenges, and in doing real knowledge work... these tasks form the practical bridge between learning and doing (p. 23).

Fullan and Langworthy (2014) identified three ways in which deep learning tasks can effectively redesign learning activities: (1) restructuring students’ learning of curricular content in more challenging and engaging ways, using digital tools and resources; (2) exposing students to real experiences in creating and using new knowledge beyond the classroom; and (3) students developing key future skills (e.g., citizenship, character education, critical thinking and problem solving, communication, collaboration, creativity and imagination) also identified as some of the 21st century competencies highlighted in this present research study. As a second step towards assessing/evaluating the design and building of digital video games as an innovative pedagogy for deep learning, how the three learning tasks implemented in the prototyping phase of this DBR process functioned as deep learning tasks to redesign the learning activities in the ways identified by Fullan and Langworthy (2014) are discussed.

Learning tasks re-structured students’ learning of curriculum content. Deep learning tasks, according to Fullan and Langworthy (2014) “re-structure learning activities from a singular focus on content mastery to the explicit development of students’ capacities to learn, create and proactively implement their learning” (p. 22). The restructuring of these learning activities is done most effectively when the tasks are:

- guided by clear and appropriately challenging learning goals, . . . that ideally incorporate both curricular content and students’ interests or aspirations. . . include specific and precise success criteria that help both teacher and student know how well goals are being
achieved. . . incorporate feedback and formative evaluation cycles into the learning and doing processes, building students’ self-confidence and ‘proactive dispositions’ (p. 22).

**Clear and appropriately challenging learning and intervention goals.** As deep learning tasks, the learning tasks in this study were guided by clear and challenging learning and intervention goals that incorporated both curricular content and teachers’ and students’ aspirations as listed in Table 23.

Table 23

*Learning and Intervention Goals Based on Curriculum Content and Teachers’ and Students’ Aspirations*

<table>
<thead>
<tr>
<th>Learning and Intervention Goals</th>
</tr>
</thead>
<tbody>
<tr>
<td>To communicate students/groups’ deep learning of the chosen curriculum content, exemplified in their deep understanding of how the citizens in their various models participated in the government decision-making process, guided by curriculum goals:</td>
</tr>
<tr>
<td>- To recognize how individuals and governments interact and bring about change within their local and national communities.</td>
</tr>
<tr>
<td>- To demonstrate an understanding of the fundamental principles of democracy.</td>
</tr>
<tr>
<td>- To analyze the structure and functions of Alberta’s provincial government.</td>
</tr>
<tr>
<td>To intellectually engage students.</td>
</tr>
<tr>
<td>To successfully participate and complete game concept development task:</td>
</tr>
<tr>
<td>- To formulate or develop effective guiding questions.</td>
</tr>
<tr>
<td>- To carry out research of the curriculum content guided by the questions in order to inform game concepts.</td>
</tr>
<tr>
<td>- To develop game concepts that strongly support the curriculum content in showing how the citizens in students’/groups’ various models participated in the government decision-making process.</td>
</tr>
<tr>
<td>- To provide initial evidence of game design principles.</td>
</tr>
<tr>
<td>- To self and peer reflect on performance and progress within the group.</td>
</tr>
<tr>
<td>To successfully participate and complete storyboarding task:</td>
</tr>
<tr>
<td>- To sketch and organize the game concepts into a sequence of the elements that would function as a road map to the actual building of the games.</td>
</tr>
<tr>
<td>- To effectively contribute to the creation of the storyboard using role-specific skills.</td>
</tr>
<tr>
<td>- To apply game aspects or game design principles in designing and developing the game elements.</td>
</tr>
<tr>
<td>- To assess the strengths and/or weakness of the design and content of storyboards using elevator pitches.</td>
</tr>
<tr>
<td>- To assess and refine the storyboards using group-share reflections.</td>
</tr>
</tbody>
</table>

(table continues)
Learning and Intervention Goals

To successfully participate and complete programming task:
- To build game prototypes based on game concepts/storyboards using the game software/Scratch.
- To apply game design principles in building the video game prototypes.
- To refine game prototypes based on peer assessments and trial and error.
- To test and try out prototypes within and across groups.

To assess individual students through a final reflection on the whole process within all the learning tasks.

Specific and precise success criteria to indicate that goals are being achieved. Specific and precise success criteria to indicate that the goals of the learning tasks were being achieved are summarised in Table 24.

Table 24

**Specific Success Criteria to Indicate that Goals Are Being Achieved**

<table>
<thead>
<tr>
<th>Learning and Intervention Goals</th>
<th>Specific and Precise Success Criteria to Indicate that Goals Are Being Achieved</th>
</tr>
</thead>
<tbody>
<tr>
<td>To communicate students/groups’ deep learning of the chosen curriculum content, exemplified in their deep understanding of how the citizens in their various models participated in the government decision-making process guided by curriculum goals:</td>
<td>Evidence of deep learning in learning tasks: knowledge creation, disciplined inquiry, critical thinking skills, higher order thinking skills, teacher-student interaction and understanding, student-student collaborative discourse, communication, active learning, formative assessment, self-assessment/peer assessment and feedback</td>
</tr>
<tr>
<td>- To recognize how individuals and governments interact and bring about change within their local and national communities.</td>
<td></td>
</tr>
<tr>
<td>- To demonstrate an understanding of the fundamental principles of democracy.</td>
<td></td>
</tr>
<tr>
<td>- To analyze the structure and functions of Alberta’s provincial government.</td>
<td></td>
</tr>
<tr>
<td>To intellectually engage students.</td>
<td>Evidence of intellectual engagement in learning tasks: flow, motivation, effort, enjoyment, interest and relevance</td>
</tr>
</tbody>
</table>

(table continues)
<table>
<thead>
<tr>
<th>Learning and Intervention Goals</th>
<th>Specific and Precise Success Criteria to Indicate that Goals Are Being Achieved</th>
</tr>
</thead>
<tbody>
<tr>
<td>To develop and use 21st century competencies.</td>
<td>Evidence of 21st century competencies in learning tasks: critical thinking, problem solving and decision making, creativity and innovation, communication, information literacy, collaboration and teamwork, living in the world - citizenship, local and global and living in the world - life and career</td>
</tr>
</tbody>
</table>

To successfully participate and complete game concept development task:
- To formulate or develop effective guiding questions.
- To carry out research of the curriculum content guided by the questions in order to inform storylines/game concepts.
- To develop game concepts that strongly support the curriculum content in showing how the citizens in students’/groups’ various models participated in the government decision-making process.
- To provide initial evidence of game design principles.

Guiding questions meet the criteria for effective questions
Research closely answers guiding questions and informs storylines/game concepts

The game concept revealed a very informative and interesting game concept that strongly supports the curriculum content in showing how the citizens in students’/groups’ various models participated in the government decision-making process and some initial evidence of game design principles. (green light)

- To self and peer reflect on performance and progress within the group.

Performance and progress within the group guided by the following four attributes: cooperation, contribution, communication, collaboration (Chapter 4).

To successfully participate and complete storyboarding task:
- To sketch and organize the game concepts into a sequence of the elements that would function as a road map to the actual building of their games.
- To effectively contribute to the creation of the storyboard using role-specific skills.

The storyboard reveals a very informative and interesting game concept (visual or written) that strongly supports the curriculum content in showing how the citizens in students’/groups’ various models participated in the government decision-making process using role-specific skills; appealing visuals that support and enhance the content and engaged players; clearly presented goals and objectives that the player had to accomplish in order to complete the game; clear and consistent game rules throughout the whole game concept; evidence of increasing levels of difficulty to challenge the players throughout the game; evidence of feedback and a reward system;

(table continues)
<table>
<thead>
<tr>
<th>Learning and Intervention Goals</th>
<th>Specific and Precise Success Criteria to Indicate that Goals Are Being Achieved</th>
</tr>
</thead>
<tbody>
<tr>
<td>- To apply game aspects or game design principles in designing and developing the game elements.</td>
<td>appropriate for target players’ skills level; easy to use so that the player can concentrate on the objectives set within the game without frustration; motivated the player and was fun to play; ready to program games. (green light)</td>
</tr>
</tbody>
</table>
| - To assess the strengths and/or weakness of the design and content of their storyboards using elevator pitches. | Provide information on what the players learn by playing your game.  
2. What are the strengths and weaknesses of your game’s content?  
3. Does your game’s content accurately reflect your own personal understanding of the topic? Explain. |
| - To assess and refine the storyboards using group-share reflections. | 1. What are we going to learn as a user of this game?  
2. Is the storyboard focused on decision making or on something else? |

To successfully participate and complete programming task:  
- To build game prototypes based on game concepts/storyboards using the game software/Scratch.  
- To apply game design principles in building the video game prototypes.  
- To refine prototypes based on peer assessments and trial and error.  
- To test and try out prototypes within and across groups.  

Building, assessing, testing and refining the first prototype (informed by storyboarded game concepts; drawing appealing visuals in an effort to support and enhance the content and engage their players; attempting to present clear goals and objectives that the player had to accomplish in order to complete the game; attempting to implement clear and consistent game rules, increasing levels of difficulty to challenge the players, feedback cycles and a reward system; ensuring that the game is appropriate for their target players’ skills level, easy to use so that the player can concentrate on the objectives set within the game without frustration; can motivate the player and is fun to play).  

To assess individual students through a final reflection on the whole process within all the learning tasks.  
1. How did you feel when you first received your assignment? Why?  
2. How has your understanding of the role changed over time?  
3. What was one area of challenge relating to your role that you overcame? How did you move past this challenge?  
4. How does your final product reflect your skill and expertise regarding your role?  
5. What are you most proud of in your final game?  
6. If you could go back and do it all again, what would you do differently in your role?  
7. How effective have you been in your assigned role for your scratch group? |
Incorporate feedback and formative evaluation/assessment cycles into the learning and doing processes. One of the features depicting the effectiveness of new pedagogies for deep learning is the incorporation of formative assessment with continuous, effective feedback into the learning process in an effort to achieve the learning goals (Fullan & Langworthy, 2014; Rushton, 2005). Black and Wiliam (1998a) characterize formative assessment as “all those activities undertaken by teachers and/or by their students [that] provide information to be used as feedback to modify the teaching and learning activities in which they are engaged” (p. 7). These activities help to provide information about a student’s progress in achieving the learning goals, the development of students’ thought processes, and any misconceptions they may have about the content being learned (Supovitz, 2012). The feedback provided (as discussed above) helps students to clarify the goals of learning, identify what they need to do to reach the goals and their progress toward achieving those goals (Hattie & Timperley, 2007).

There is no prescription as to what these formative assessment activities should comprise (Trumbull & Lash, 2013). Therefore, to promote or encourage the creation of that new knowledge in both the game concept development and storyboarding tasks, for instance, teachers incorporated weekly assignments in Edmodo, frequent instructional conversations, discussions and/or Socratic dialogues/questioning between themselves and student group members to stimulate critical and deeper thinking and understanding of the government decision-making process, which also involved a great amount of coaching and scaffolding with teacher feedback as formative assessments into these tasks. As they participated in these assessments to achieve the learning and intervention goals, students or group members articulated or explained, debated and defended their ideas for their game concepts and storyboards to their teachers and peers.

In the programming task, to achieve the learning and intervention goals, students/groups heavily depended on a peer assessment/reflection/feedback/test/refinement cycle strategy. This
represented a formative assessment of their work and informed the ongoing analyses of the students’/groups’ activities leading to iterations of the prototypes and helped to mainly promote a deep learning of the game software/Scratch and game design principles used to build the game prototypes (as described in Chapter IV and findings resulting from their utilization in Chapter V). Figure 9 shows where formative assessment and feedback loops appeared in the actual implementation of the learning tasks in the designed process.

**Learning tasks provide real experiences in creating and using new knowledge.** “In deep learning tasks, the goal is to develop new knowledge, through the integration of prior knowledge with ideas, information and concepts, into a wholly new product, concept, solution or content” (Fullan & Langworthy, 2014, p. 23). As students/groups participated in the learning tasks’ activities, they were exposed to real experiences, “messy and unpredictable” (Hudler, 2013) learning experiences, in creating and using new knowledge mostly within the classroom, but with relevance for use beyond the classroom.

In this research study, new knowledge is taken to include “knowledge that is created by the student, whether or not it is new in the broader scope of knowledge that exists” (Fullan & Langworthy, 2014, p. 22). Knowledge creation was taken to include constructing knowledge using varied information sources, integrating new knowledge and understanding with their own prior cognitive structures and contributing new ideas resulting in new knowledge products (students’ game artifacts including game concepts, storyboards and game prototypes).

In the game concept development task, students/groups created new knowledge (game concept artifacts) through a process of developing effective questions that guided the research, which informed the creation of the storylines/game concepts. In the storyboarding task, students/groups’ created new knowledge (storyboard artifacts) by sketching and organizing the game concepts into a sequence of the game elements that would function as a road map to the
actual building of their video games. During this task, students/groups also tended to develop new knowledge about their role-specific skills (e.g., story writing, art, music/sound engineering, programming), technologies (apps) and game design principles. The creation of new knowledge in these tasks was strongly supported by formative assessments provided by teachers and peers.

In the programming task, students/groups’ created new knowledge (game prototypes) by engaging in the coding/programming of their storyboarded ideas based on their game concepts using the game software/Scratch. To create that new knowledge, students/groups heavily depended on the peer assessments/reflections and feedback mainly from their peer group members, and trial and error experiences to continuously refine the prototypes being built.

To assess how each student contributed to the creation of that new knowledge throughout the whole process, a summative assessment was carried out through a final reflection on the whole process of all the learning tasks guided by a collaboratively designed rubric between teachers and their students. In terms of new knowledge creation, these learning tasks may be located in the middle stage or stage of development of the Tasks and Assessments component on Fullan and Langworthy’s (2014) Continuum of New Pedagogies Effectiveness (see Figure 47).

![Figure 47. Location of learning tasks in Tasks and Assessments component of Fullan and Langworthy’s (2014) Continuum of New Pedagogies Effectiveness](image)

**Theoretical orientation of learning tasks in creating new knowledge.** In terms of theoretical orientation, Fullan and Langworthy (2014) stipulate that in the creation of new knowledge, deep learning tasks have a “constructivist orientation, with an emphasis on the
application of [that] new knowledge in real contexts” (p. 23). In this research study, teachers indicated that the learning tasks’ activities, which guided students’ creation of their new knowledge (game artifacts) were also initially designed and informed by constructivist ideas. However, as they continued to design and implement the learning tasks, it became evident that the learning tasks’ activities were also designed and informed by additional theories, indicating that it is also possible for deep learning tasks to have multiple theoretical orientations, at the same time.

For instance, teachers also seemed to be incorporating constructionist learning principles as they encouraged students/groups to collaboratively construct their new knowledge/ideas, in the game concept and storyboarding tasks, through inquiry/learning, discussions, brainstorming, research, invention and personal reflection (Papert, 1991) and then to effectively use their new knowledge/ideas to construct personally meaningful products or their own video game prototypes in the programming task.

Teachers also seemed to be incorporating connectivist ideas to support students’/groups’ creation of their new knowledge. Siemens (2004, p. 4) proposes that connectivism is a learning theory for the digital age and is guided by eight core principles:

- Learning and knowledge rests in diversity of opinions.
- Learning is a process of connecting specialized nodes or information sources.
- Learning may reside in non-human appliances.
- Capacity to know more is more critical than what is currently known.
- Nurturing and maintaining connections is needed to facilitate continual learning.
- Ability to see connections between fields, ideas, and concepts is a core skill.
- Currency (accurate, up-to-date knowledge) is the intent of all connectivist learning activities.
Decision-making is itself a learning process. Choosing what to learn and the meaning of incoming information is seen through the lens of a shifting reality. While there is a right answer now, it may be wrong tomorrow due to alterations in the information climate affecting the decision.

Based on these principles, connectivism can help to explain, create, sustain and distribute learning across networks linking humans to other humans and to non-human resources because knowledge resides in networks of humans and non-human appliances (Siemens, 2005; Bell, 2011). Connectivism became evident in the learning tasks, as the teachers linked students/groups to their peers and the non-human appliances or resources (Edmodo, hardware, game software/Scratch, SMART board, videos, blogs, and so on) to collaborate, communicate, support and share their learning and understanding of how the citizens in their various models participated in the government decision-making process.

Linking students to groups through specific roles, and groups to groups were, according one of the teachers, necessary to keep students moving forward during the process. Students needed to work as an effective group using more authentic collaboration, hence the strong emphasis on the collaborative aspect of the process. The teachers further indicated that linking students/groups to the various resources or technologies, for instance, was also necessary to give them as many opportunities and a variety of opportunities to express what it is that they know.

Although it was not discussed with the teacher participants during the mid- and post interviews, a possible theory that informed the learning tasks’ activities was assessment theory, more specifically, the contribution of assessment for, as and of learning to assessment theory that can inform practice. It was evident from the findings that assessment for learning (AFL) (Black, Harrison, Lee, Marshall & Williams, 2003; Earl, 2003; Taras, 2010) was exemplified as teachers embedded continuous formative assessments in the tasks’ activities to assess students’/groups’
progress, promote student learning and inform modifications or refinement to the instructional and learning tasks’ activities to meet students’ learning needs.

In using AFL, teachers ensured that the learning goals were explicit and gauged students’ prior knowledge to assist their clear understanding of what they were trying to learn and what was expected of them. During these assessments, students were actively involved in their learning (explaining, debating, defending and reflecting on their ideas) as they aimed to get a deeper understanding of how the citizens in their various models participated in the government decision-making process.

Assessment as learning (Earl, 2003) emphasizes assessment as an integral part of the process of learning experienced by the students. In this research study, it was evident from the findings that students’ engagement in self and peer assessments (Let’s Reflect rubric, students’/groups’ reflections in their Kidblogs, elevator pitches and group-share reflections with feedback for improvement) helped to establish their roles and responsibilities in assessing their own learning as well as to promote their confidence and self-esteem through an understanding of how they learned.

Assessment of learning (Black, 1998) provides summative assessment of students’ achievement of the learning goals at the end of the process. In this research study, individual students were summatively assessed on (i) how they contributed to meeting the learning goals through their assigned roles; (ii) the progressive understanding of their roles throughout the whole process; (iii) the challenges encountered through their roles and how they addressed those challenges to meet the learning goals; and (iv) what they would change in their assigned roles to meet the learning goals given the opportunity to participate in another project involving the design and building of digital video games. The results of this summative assessment were used by the teachers as evidence of each student’s achievement of the learning goals and to inform
their plans for future learning goals and implementation of the design and building of digital video games in their practice.

Another possible theory that seemed to inform the learning tasks’ activities was scaffolding theory to support scaffolding in game design. It was clear from the findings on teachers’ extensive use of coaching and scaffolding, during the game concept development and storyboarding tasks, that students required additional guidance and support to develop their game concepts and create and design their storyboards to inform the building of their video games. Teacher’s design of that guidance and support tended to reflect the Cates and Bruce’s (2000) Model of Scaffolding, which was initially designed to provide scaffolding to students as they interacted with computers (see Figure 23) and portrays the specific type of scaffolding that may be required for learning acquisition and transfer to occur from an instructional gaming environment (Weppel, 2014).

**Development of key future skills/21st century competencies in learning tasks.** Fullan and Langworthy (2014) stipulate that the 6 Cs or key future skills (character education, citizenship, communication, critical thinking and problem solving, collaboration and creativity and imagination) are “explicitly or intrinsically developed through deep learning tasks” (p. 24). These key future skills also formed part of the 21st century competencies developed and used by the students/groups in this present research study. Findings indicated that as students participated in the learning tasks’ activities to create their new knowledge (game concepts, storyboards and game prototypes), they seemed to become even more proficient and skilled in all the 21st century competencies (see Figures 40-43).

Findings also revealed that not only were these competencies developed in the learning tasks, they also seemed to help promote students’ deep learning of the curriculum content and other emerging content in the process, at the same time—reciprocal relationship. The teachers
stated that the 21st century competencies functioned as an inherent feature or characteristic of the design and building of the video games. All the competencies seemed integral to student deep learning as they worked to achieve the goals of the learning tasks. In support of this claim, to some extent, Pellegrino et al. (2012) explain that 21st century competencies enable students to rigorously master academic content as they learn how, why, and when to apply their new knowledge to answer questions and solve problems.

Intellectual engagement in learning tasks. Although Fullan and Langworthy (2014) did not specifically discuss how student engagement, particularly, intellectual engagement could be an intrinsic feature of deep learning tasks, the findings in this present research study concerning the impact of the design and building of digital video games on students’ intellectual engagement helped to reveal that it is possible to explicitly or intrinsically develop students’ intellectual engagement through deep learning tasks. The teachers stated that, like 21st century competencies, intellectual engagement functioned as an inherent feature or characteristic of the design and building of the video games.

Findings indicated that as students/groups participated in the learning tasks’ activities, in partnership with their teachers and peers, to create new knowledge (game concepts, storyboards and game prototypes), intellectual engagement was clearly evident throughout this experience, but highest during the storyboarding task (see Figures 36-39). This finding is supported by other research into student intellectual engagement in the classroom. Dunleavy and Milton (2009) noted that authentic intellectual engagement requires a deeper reciprocity in the teaching-learning relationship where students’ engagement begins as they actively construct their learning in partnership with teachers, work toward deep conceptual understanding, and contribute their own ideas to building new knowledge (p. 14).
More specifically, findings also revealed that there was a reciprocal relationship between the intellectual engagement themes (flow, motivation, effort, enjoyment, interest and relevance), as one depended or led to the other in students’ intellectual engagement experiences during their participation in the learning tasks’ activities. Through researcher and teacher observation and students’ description of their learning experiences, it became evident that most student interest was highly sustained by the relevance of the learning tasks’ activities to meeting their learning goals and to future roles in their own lives. High interest and relevance also seemed to stimulate and sustain students’/groups’ motivation to participate in the learning tasks’ activities, particularly during the storyboarding task, as they tried to achieve the goals of the tasks, do their tasks’ activities very well, remain on, and complete their tasks’ activities and work well within their groups.

The relationship between students’ high interest in the learning tasks’ activities, and their motivation to invest a huge amount of time and effort into their work, especially as they tried to overcome the many challenges that they encountered as they performed their role-specific activities, was most evident in the storyboarding task. That interest, motivation and effort helped most students/groups to experience that flow state leading to their complete involvement, focus and concentration, to the point where students would lose track of time and had fun and enjoyed participating in the tasks’ activities.

This discussion of how the teachers, in this present research study, re-structured students’ learning of the curriculum content in the learning tasks, a feature of deep learning tasks, and the location of these tasks in, at least, the development stage on Fullan and Langworthy’s (2014) Continuum of New Pedagogies Effectiveness continue to demonstrate the effectiveness of the design and building of digital video games in meeting the requirements of new pedagogies for deep learning.
Access to Digital Tools and Resources/Technologies in the Design and Building of Digital Video Games

Digital learning tools and resources/technologies, the third component of the new pedagogies, according to Fullan and Langworthy (2014), have the “potential to enable, expand and accelerate learning in ways previously unimaginable” (p. 30). Research has shown that digital learning tools and resources/technologies have had little impact in education and are generally used as delivery platforms for traditional pedagogies, rather than leveraging them for creativity and engaging students in deep learning (Cuban, 2013; Dede, 2014; Fullan, 2013; Fullan & Langworthy, 2014; Murray & Olcese, 2011).

Dede (2014) noted that “while it is possible to teach for deeper learning without technology, it is hard to imagine how . . . schools will scale up such instruction without support from digital tools and media” (Dede, 2014). According to Fullan and Langworthy (2014), that support can be provided in new pedagogies in which technology enables the discovery and mastery of new content knowledge; local and global collaborative, connected learning; creation and use of new knowledge with authentic audiences for ‘real’ purposes; and enhancement of teachers’ ability to put students in control of the learning process, accelerating learner autonomy.

Based on the findings in this present research study, the use of various digital learning tools and resources/technologies by the teachers and students/groups was integral to the discovery of new content to create new knowledge, for local collaboration, connected and intellectually-engaged learning. The meaningful use of technology also helped to enhance the teachers’ ability to promote a more student-managed or –centred learning process, accelerating learner autonomy and the development and use of 21st century competencies, all contributing to that deep learning in the learning tasks’ activities.
As teachers planned and implemented the learning tasks, they used and interacted with digital learning tools and resources/technologies mainly to collaboratively work with their students to provide guidance and support to students/groups in creating new knowledge, to assess their progress, and to eventually accelerate that learner autonomy. More specifically, they used interactive whiteboards and whiteboard videos for the teaching moments, Edmodo for providing continuous assignments and feedback on assignments and student progress. In the programming task they took a hands-off approach and allowed the students to manage most of the task’s activities, but kept that teacher-student/group connection using resources such as Edmodo and the Kidblogs. As such, their use of these digital learning tools and resources/technologies can be located on Fullan and Langworthy’s (2014) Continuum of New Pedagogies Effectiveness, in the middle stage or stage of development of the Tech Use by Teacher component (see Figure 48).

![Figure 48. Location of teacher use of digital learning tools and resources/technologies in Tech Use by Teacher component of Fullan and Langworthy’s (2014) Continuum of New Pedagogies Effectiveness](image)

Students also used various digital learning tools and resources/technologies as tools to discover new content to create their new knowledge that would help to intellectually engage them in a deeper understanding of how the citizens in their various models participated in the government decision-making process, to develop and use 21st century competencies and to gain exposure to the ways in which they will be expected to work in the knowledge society and complex world of work. These tools/technologies included iPads, laptops to supplement the
iPads, which were posing some challenges in students’ use of the game software/Scratch and the limited number of iMacs for the programming task, the game software, Scratch, Google documents to collaboratively develop their game concepts and storylines/game concepts, kidblogs to reflect on their experiences and progress throughout the learning tasks and videos for self-assessments.

Some of the students indicated that during the storyboarding and programming tasks, in particular, they also made great use of the Internet, various apps, such as Sketch pad to create backgrounds and characters, pixel app to change pictures into pixels, iMessages, FaceTime and Email to collaborate and communicate with programmers, Bamboo, Notebook, GarageBand, Tabletop, and Glitching apps (Chapter 5). As such, their use of these digital learning tools and resources/technologies can be located on Fullan and Langworthy’s (2014) Continuum of New Pedagogies Effectiveness, in the middle stage or stage of development of the Tech Use by Student component (see Figure 49).

![Figure 49](image)

In short, in the foregoing, I have attempted to demonstrate how the design and building of digital video games, implemented and explored in three learning tasks in the local context, a charter school in Calgary, successfully meets the requirements for the three core components of the new pedagogies for deep learning—new learning partnerships, deep learning tasks and access
to digital tools and resources. In terms of its effectiveness as an innovative pedagogy for deep learning, it is mostly located in the development stage on Fullan and Langworthy’s (2014) Continuum of New Pedagogies Effectiveness indicating that it’s well on its way in becoming an effective innovative pedagogy. The results of this assessment/evaluation and reflection indicate that the design and building of digital video games, as implemented in this present research study, does have the potential to function as an innovative pedagogy for deep learning in the local context or school that K-12 educators can use to intellectually engage their students in deep learning of curriculum content and continued development and use of 21st century competencies.

To further evaluate or assess and reflect on the effectiveness of the design and building of digital video games as implemented in this research study, I will now set the findings of this present research in another context by comparing them to findings from previous research studies identified in my review of the literature, spanning from the 1990s to the present.

Comparison of Findings from Present and Past Research Studies on the Design and Building of Digital Video Games in and Beyond the School Context

This comparison will focus on (i) common or consistent outcomes in both present and past findings and outcomes unique to the present research study; (ii) concerns identified in past findings that were possibly addressed in the present research study; (iii) claims emerging from present research study that can possibly bridge or narrow some of the gaps in game-based learning research.

Common Outcomes and Experiences in Past and Present Research Studies

In comparing the findings from this and past research studies in the design and building of digital video games in and beyond the school context, common or consistent learning outcomes and experiences clearly emerged. For instance, in both the present findings and those that
emerged from the formal classroom context in past studies, the design and building of digital video games was used an authentic context for embedding the curriculum content. It also promoted:

- increased curriculum content retention (Owston, Wideman, Sinitskaya & Brown, 2009);
- higher engagement in activities (Owston, Wideman, Sinitskaya & Brown, 2009);
- motivation and enthusiasm for learning (Robertson & Howells, 2008);
- determination to reach a high standard of achievement (Robertson & Howells, 2008);
- application of learning to new situations (Robertson & Howells, 2008);
- increased knowledge of the game software (Owston, Wideman, Sinitskaya & Brown, 2009);
- significant improvements in active learning, higher-order thinking and critical thinking (Yang & Chang, 2013);
- greater potential for student empowerment through enhancing concentration (Yang & Chang, 2013).

In both the present findings and those that emerged outside the formal classroom context in past studies, the design and building of digital video games also seemed to promote:

- student engagement in fantasies, relationships with other forms of reality that went beyond traditional school approaches and systematic planning, critical analysis and collaborative learning (Kafai, 1995; Li, 2010);
- learner autonomy by putting the student in control of their own learning and thinking and challenging them to plan and manage the complex process of creating their own game (Kafai, 1995);
- learner involvement in all the design decisions (Kafai, 2006);
- development of technological fluency—“involves not only knowing how to use new technological tools but also knowing how to make things of significance with those tools and most important, develop new ways of thinking based on use of those tools” (Kafai, 2006, p. 4);
- construction of personal representation of knowledge by using physical artifacts (Egenfeldt-Nielsen, 2006);
- learning of the design process (Li, 2010);
- customization of the learning experience to fit students’ unique needs (Li, 2010);
- the extrinsic integration of game elements and curriculum content more than intrinsic integration (Kafai, 1998).

**Unique Outcomes and Experiences in Present Research**

The present findings also revealed some outcomes that did not seem to appear or rarely appeared in the findings of past studies within and outside the formal classroom context. For instance, in this DBR study, the implementation of the design and building of digital video games in the formal classroom context also seemed to promote:

- a more complex interactive learning community network with multiple interaction modes for collaboration and communication;
- deep collaboration, communication, cooperation and contribution within and between groups of students in their assigned roles, between teachers and their students and between teachers;
- emerging roles for teachers (e.g., activators and designers of student learning, collaborators, learning coaches, reviewers and models in their pedagogical capacity);
- emerging roles for students (e.g., historians, inventors, project-managers, debaters, apprentices, learning coaches, reviewers/assessors, designers of their own learning; teachers);
- deep learning of the chosen curriculum content, role-specific skills, game aspects or game design principles and various technologies, including apps—involved knowledge creation, disciplined inquiry, critical thinking, higher order thinking, active learning through authentic forms of formative assessments and self and peer assessments with feedback loops; deep learning was more evident as the learning tasks were implemented rather than in 95% of final game prototypes;
- connection between social studies and other disciplines—Story writing, Art, Music/Sound Engineering, Programming/Coding, Leadership, Research;
- student intellectual engagement throughout the learning tasks—involved flow, motivation, effort, enjoyment, interest and relevance;
- student development and use of 21st century competencies throughout the learning tasks—involved critical thinking, problem solving and decision making, creativity and innovation, communication, information literacy, collaboration and teamwork, living in the world - citizenship, local and global and living in the world - life and career;
- engaged teaching (Dunleavy & Milton, 2009);
- more extensive use of coaching and scaffolding to help students learn and understand the chosen curriculum content, game aspects or design principles;
- context-dependent authentic assessments with feedback loops;
- conceptual thinking and learning for “students to sort through misconceptions, learn new ideas and create or improve upon ideas” (Dunleavy & Milton, 2009, p. 13);
- divergent thinking;
- increased theoretical support for design of instructional learning tasks’ activities—constructivism, constructionism, connectivism, assessment theory, scaffolding theory;
- the use of design principles that effectively support or guide the specific learning task activities/ideas in the design and building of video games (see Figure 20).

These common and unique outcomes may help to solidify the claims made about the effective pedagogical usability of the design and building of digital video games or its potential and effectiveness as an innovative pedagogy to promote student intellectual engagement in deep learning and development of 21st century competencies in preparing them for the knowledge society and to competently function in today’s complex world. As part of these outcomes, there were some concerns expressed by past researchers on the implementation of the design and building of video games within and outside the formal classroom contexts. A discussion of these concerns and how they may have been possibly addressed in this present research will help to further inform the effective pedagogical usability of the design and building of digital video games and its potential and effectiveness as an innovative pedagogy for deep learning.

**Addressing Concerns in Game Design-Based Research Outcomes**

Some of the concerns identified in past research studies on the design and building of video games within the formal classroom contexts included: (i) curriculum content in game prototypes more extrinsically than intrinsically integrated (also a concern in Kafai’s (1998) research study outside the formal classroom context); (ii) students more interested in designing and building games rather than learning the curriculum content; (iii) assessments/evaluation in the design and building of digital video games; (iv) scaffolding in the design and building of digital video games; and (v) pedagogical usability and effectiveness in the school context.

**Curriculum content in game prototypes more extrinsically than intrinsically integrated.** In their findings on the use of video game design and building as a context for
learning and teaching math concepts, Kafai (1998) and Shaw, Boehm, Penwala and Kim (2012) revealed that the math concepts/curriculum content were more extrinsically integrated (game elements and curriculum content are unrelated) than intrinsically integrated (game elements and curriculum content are related) into the game prototypes (Kafai, 1998). One of the reasons offered for this extrinsic integration of the curriculum content in children’s games as they designed and built them has been the influence of extrinsic models in commercial digital learning software and in the formal education system (Habgood, Ainsworth & Benford, 2005).

In the present research findings, as the students/groups created their game artifacts (game concepts, storyboards and prototypes), there was also evidence of this extrinsic integration of the social studies content with the game elements in the initial creation of the game artifacts in some of the groups. In developing their game concepts, for example, it was observed and confirmed by teachers that some groups (10 of the 20) became overly focused on the details that led to the problem and were creating game concepts that had very little (8 groups) or nothing (2 groups) to do with how the citizens in their various models participated in the government decision-making process in the initial versions of their game concepts. Students needed to incorporate more of that content into the game concepts. This resulted in these groups receiving yellow and red lights.

In creating their storyboards, it was also observed and confirmed by the teachers that the initial attempts of the storyboards of eight groups had insufficient content on how the citizens in their various models participated in the government decision-making process, although they had incorporated it into their game concepts, resulting in yellow lights. The storyboards of two groups had no content on how the citizens in their various models participated in the government decision-making process, although they had incorporated it into their game concepts, resulting in red lights. Therefore, to address this issue on the extrinsic integration of the social studies
curriculum content with the game elements, teachers used continuous formative assessments (including extensive amount of coaching and scaffolding) with teacher feedback, self and peer assessments with feedback and students’ reflections in their kidblogs, until all groups intrinsically integrated the curriculum content on how the citizens in their various models participated in the government decision-making process with the game elements informed by game aspects or design principles.

In ten of the eleven game prototypes submitted, the extrinsic integration of the curriculum content on how the citizens in students’/groups’ various models participated in the government decision-making process with the game elements was more evident than the intrinsic integration. The curriculum content used was not as detailed as that researched in their game concepts and storyboarded. Students didn’t show or expose enough of that content or aspects of the game unit. The teachers explained that possible reasons for this included the groups’ difficulty in representing the details from their storyboards in the game software/Scratch due to their limited experience with the software and the challenges they encountered in making sure that the groups had access to laptops with full features of Scratch. These played a significant role in this transition and were major obstacles. Students also explained another possible reason was the limitation of Scratch in representing their ideas. Insufficient time, along with the distance problem, were also possible factors contributing to this issue.

The effective use of continuous formative assessments (including an extensive amount of coaching and scaffolding) with teacher feedback, along with self and peer assessments with feedback and students’ reflections in their kidblogs to promote more intrinsic integration of the curriculum content and game elements, informed by game aspects or design principles, into the game design process could have implications for future exploration of the design and building of digital video games in and beyond the school context. Given more time and access to relevant
resources, the peer assessment/reflection/feedback/test/refinement cycle strategy used in the programming task by student peers could also possibly help to address this extrinsic versus intrinsic integration issue in building the game prototypes.

Students more interested in designing and building games rather than learning the curriculum content. Closely related to the previous concern, in their research, Shaw, Boehm, Penwala and Kim (2012) also reported that during the process, the students seemed to be more focused on creating the game and less interested in learning the chosen curriculum content or domain knowledge for their games. In the initial creation of the game artifacts (game concept and storyboards) this was also a concern in the same 10 groups identified above, in this present study. As in the previous concern, teachers made use of continuous formative assessments, promoted self and peer assessments and encouraged students’ reflections in their kidblogs to successfully ensure that students/groups were focusing on how the citizens in their various models participated in the government decision-making process as well as the game elements, informed by game aspects or design principles, particularly in the game concept and storyboarding tasks.

In the programming task, it was more challenging to address this concern because of the mitigating factors identified in the previous outcome. Like the previous concern, in future research focusing on the design and building of digital video games in and beyond the school context, for example, this issue could be addressed with the effective use of continuous formative assessments (also include an extensive amount of coaching and scaffolding), self and peer assessments with feedback loops and extensive student reflection.

Assessment in the design and building of digital video games. The teachers in Shaw et al.’s (2012) project reported that assessment of student performance and progress as they designed and built their video games was also a challenge because “students did not take
assessments seriously” (p. 11). The assessment strategy used by teachers in this present study could have implications for addressing such a challenge in this and other future exploration with the design and building of digital video games in and beyond the school context. The teachers in this present research study continuously used different forms of assessments because of the game context and their belief that “assessment isn’t something that you do to kids, it’s something that they’re a part of” (Post interview, June 2014).

As a result, they ensured that the students/groups were actively involved in (i) the assessments for their learning (weekly assignments, instructional conversations, discussions, Socratic dialogues/questioning, and coaching and scaffolding with feedback loops involving large amounts of descriptive feedback) to assess their progress and to inform the modifications or refinement to their work; (ii) the assessments as their learning (self and peer assessments—Let’s Reflect rubric, students/groups’ reflections in their Kidblogs, elevator pitches and group-share reflections with feedback for improvement); and (iii) the assessments of their learning (summative assessment of students’ achievement of the learning goals at the end of the process).

This multifaceted approach to assessment helped to stimulate and sustain students’/groups’ interest in their learning and engaged them in taking these assessments very seriously. This also reflects one of the recommendations made by Lim (2008) on the fundamental changes that are necessary for game development to truly support student learning—focusing on assessment for deep versus surface learning instead of assessment for evaluation.

**Scaffolding in video game design and building.** In their research, Tzuo, Isabelle, Ling, Yang and Chen, (2012) pointed out that there is scant work on teacher-student interaction to guide teachers in whether they should provide scaffolding to students when students interact with computers in the context of
[designing and building digital video] games. If they should, in turn, it is not clear what kind of guidance they have to provide” (p. 425).

In this present study, this did not seem to be a concern. The teachers used a scaffolding model (see Figure 2) that tended to reflect the Cates and Bruce’s (2000) Model of Scaffolding, which was initially designed to provide scaffolding to students as they interacted with computers.

The teachers provided scaffolding to students from the initial tasks—game concept development and storyboarding tasks leading to the programming task when students/groups interacted most with computers. During that task, students were given more control of their learning and the scaffolding was mostly provided by peers, thus encouraging more learner autonomy. Teachers described the scaffolding used in the process as the most intense part of the process for them and their students. Teachers’ approach to providing scaffolding in this video game design and building context can, therefore, be used as a model for other video game design researchers with similar concerns.

**Pedagogical usability and effectiveness in the school context.** Tzuo, et al. (2012) also reported that “No matter how game design has been greatly developed in order to enhance students’ learning, its pedagogical usability to school implementations, including why, when, and how to use it is still ambiguous and not consolidated yet” (p. 420). Based on the implementation findings of this present research study, the pedagogical usability to school implementation may still be a concern, to some extent with ‘when’ and some aspects of ‘how’ and would need to be addressed in further research into the implementation of the design and building of digital video games in the school context.

The findings describing its implementation in the local context/charter school, however, could serve as a model to address at least ‘why’ and some aspects of ‘how’ teachers implemented it (see Chapter 4). The ‘why’ in this present research was to find a new way or pedagogy that
would ultimately challenge students to learn and communicate their deep understanding of chosen social studies curriculum content, become intellectually engaged and develop and use 21st century competencies. Teachers also used this intervention to focus on their assessment practices, asking themselves some difficult questions like: What matters? What is it that we want to learn? How were they going to know students learned it?

In this present research study, the main concerns with ‘when’, in the implementation of learning tasks mainly resulted from (i) time allocated to the process—the restructuring of the timetable, which was prepared before the implementation of the learning tasks, because of the flexibility of the school’s activities—always trying something new; (ii) time constraints—resulting from internal/administrative difficulties setting up hardware in the library since it was very difficult to use the game software/Scratch on the iPads, difficult collaboration and challenges with the tasks’ activities in groups, slow Internet connection and challenges of the distance between the programmer and the rest of the group during the programming task, all impinging on the amount of class time that most groups had to complete at least the first prototype of their games.

The main concern with ‘how’ was mostly associated with the environment aspect of the ‘how’ for optimum success in building the game prototypes. This resulted from the distance problem (programmer being up in the library and the other four group members in the classroom), which negatively impacted the cohesiveness of the group, students’ access to hardware resources, such as laptops whenever they needed it, teachers’ presence with all the groups—difficulty being in two places at one time and making sure that the hardware resources worked.

Tzuo, et al. (2012) also explained that according to their practical experience in schools, teachers had difficulty tying video game design and building with the curricula. In this present
research study, when questioned as to whether it was a challenge to integrate or tie the design and building of digital video games into the social studies curriculum, teachers responded that they had no difficulty because this game unit was designed based on the curriculum. Their main challenges, however, were to choose the aspect of this broad curriculum for the unit and the increased amount of time and effort that would be needed to implement it. Despite these challenges and concerns, the design and building of the video games, implemented by the teachers with some researcher input, does have the potential and seem to qualify as a developing effective innovative pedagogy for deep learning in its first cycle, as discussed in the previous section.

**Addressing/Narrowing Gaps in Game Design-Based Research**

In the review of the game design-based research literature, a number of gaps have been revealed. The findings of this present research study will, however, appear to address five of these gaps. The findings begin to address the need for (i) more innovative teaching and learning approaches or pedagogies for deep learning; (ii) more innovative learning practices that can promote and support the development and use of 21st century competencies; (iii) effective innovative pedagogies or participatory learning environments for student intellectual engagement; (iv) game design and building as assessments for, as and of learning in school; and (vi) game-making or game design and building to foster deep collaboration.

**Deep learning pedagogy.** In an effort to make education more relevant to the needs of today’s students, an increasing number of educators, parents and employers are calling for new or innovative approaches to teaching and learning with technologies or promising pedagogies that would effectively impact students’ engaging and deep learning. These approaches or pedagogies would also allow them to develop skills to learn and think for themselves—skills they can
develop by doing, using real world experiences in order to contribute to today’s complex world (Millar, 2015).

Fullan and Langworthy (2014) identified and described three core components of these new pedagogies—new learning partnerships, deep learning tasks and access to digital tools and resources. In section one of this discussion, these components were used as part of a framework to assess or evaluate and reflect on whether the design and building of digital video games, as implemented in this present research study, would qualify as one of these new or innovative approaches or pedagogies. Based on this assessment/evaluation and reflection, using the findings of this study, it was determined that the design and building of digital video games as implemented in the school context, a charter school in Calgary seem to qualify as one of these innovative pedagogies, more specifically for deep learning.

**Innovative practice to support 21st century competencies.** Twenty-first century competencies are considered to be crucial to student learning and curriculum innovation (Simanowski, 2009) and critical success factors in the knowledge society (Earp, et al., 2013). Developing these competencies in K-12 education, for instance, would support deeper learning of curriculum content and help to prepare students for a more successful transition into the complex world of work (Hilton, 2015). As such, educators need to adopt and implement innovative learning practices that can promote and support the development and use of 21st century competencies in school. To address this need, it has been argued that the design and building of video games can support the development of 21st century competencies (e.g., Clark & Sheridan, 2010; Salen & Zimmerman, 2003; Shaffer, 2006; Zimmerman, 2007). However, more evidence-based proof is required to establish whether it is actually an effective and engaging pedagogical strategy that contributes to the development of 21st century competencies.
The findings concerning the development and use of 21st century competencies in this present research study help to support, provide evidence and add to the research on the usefulness of the design and building of digital video games or learning by making digital games (LMDG) to the development of 21st century competencies (Earp, et al., 2013). The teachers in this present research study reported that the development of 21st century competencies was an inherent feature/characteristic or by-product of the design and building of digital video games.

**Innovative practice and/or participatory learning environment for student intellectual engagement.** Intellectual engagement, “a serious emotional and cognitive investment in learning, using higher order thinking skills (such as analysis and evaluation), to increase understanding, solve complex problems, or construct new knowledge” (Willms, Friesen & Milton, 2009, p. 7) is also considered to be critical to student learning in preparing them to move into “ever-changing and complex social, economic, political and cultural contexts” (Jacobsen & Friesen, 2011, para. 1).

In the context of game-based learning, documented research on the impact of intellectual engagement is sparse. The few studies in which it has been researched and documented have been with reference to game playing (McClarty, Orr, Frey, Dolan, Vassileva & McVay, 2012; Shute, Ventura, Bauer & Zapata-Rivera, 2009; Sproedt, 2012) with little or no reference made to game making or the design and building of digital video games. Findings from this present research study helps to narrow this gap in the game-based learning research literature by providing evidence of students’ intellectual engagement as they participated in all the learning tasks’ activities during which they designed and built their video games. It can represent an effective innovative pedagogy or participatory learning environment for student intellectual engagement. The teachers, in this present research study, reported that like the development of
21st century competencies, intellectual engagement is an inherent feature/characteristic or by-product of the design and building of digital video games.

This claim is further supported by evidence indicating that the three learning tasks, the stages in which the actual design and building of the video games took place involved active [and collaborative] learning, choice and expression; required deep [and critical thinking], which resulted in deep understanding; immersed students/groups in authentic, discipline-rich inquiry; connected students/groups socially, with various technologies and the world outside the classroom (historically and in the present); involved significant amount of conversation, collaboration and creation of ideas; involved teaching and expertise that was provided to the students/groups; involved the appropriate and prevalent use of educational technologies; made extensive use of formative assessments (including extensive coaching and scaffolding), and self and peer assessments with feedback loops and summative assessment (Jacobsen, Lock & Friesen, 2013, Great Inquiry Projects: Design tips for teachers section).

**Assessment of, for and as learning in the context of video game design and building in school.** The research on assessment in game-based learning has primarily focussed on the role of games in assessment of learning (e.g., Zapata-Rivera & Bauer, 2012), assessing games for learning (e.g., Shute, Ventura, Bauer, & Zapata-Rivera, 2009) assessment of learning in games (e.g., Bellotti, Kapralos, Lee, Moreno-Ger & Berta, 2013; Chin, Dukes & Gamson, 2009; Schaaf, 2015; Shute, 2011; Shute & Ke, in press; Shute, Masduki & Donmez, in press; Zapata-Rivera, VanWinkle, Doyle, Buteux & Bauer, 2009) and games as formative assessments (e.g., Delacruz, 2011). Research into assessments and learning through game design and building is sparse (e.g., Li, 2013). This study provides some strong insights with regards to assessment of, for and as learning in the context of video game design and building in school.
Findings in this present research on teachers’ use of assessments for, as and of learning to promote a deep learning of the chosen curriculum content, assess students’ progress and achievement during and at the end of the process, allow students/groups to make a better change towards improvement and inform their instructional modifications to the tasks’ activities can help to narrow this gap on the use of assessments in game design-based learning (see Figure 23). These findings can also help to address/narrow the gap in the literature on how video game design and building can promote the creation or development of assessments for, as and of learning in the formal classroom context.

Teachers noted that in this game design and building context, they had to be creative and deliberately developed and adapted various forms of assessments that reflected the context and the nature of their students, ensured that the students were a part of the assessments and challenged their own methods of assessments, as the process continued. In using these assessments, teachers also noted that assessing student learning throughout the game design process was more critical to guide their instruction and promote deep learning or achieving the learning goals than just assessing for the final outcome or game prototype. In other words, the process mattered more than the outcome since “assessment must mirror learning” (Johnson, 2015, Requirements section, para. 1).

**Game-making or video game design and building to foster deep collaboration.**

Bermingham et al. (2013) note that “collaboration is an important aspect of constructing or making games” (p. 49). In reviewing the literature on collaborative game-making or game design and building activities in the classroom, they claimed that they found only one study by Denner et al. (2005) in which games were built by teams of at least two learners. In most of the studies on game-making or the design and building of digital video games in the classroom, they noted that learners constructed their games individually. Collaboration was restricted to the evaluation
process when the game-making process was in its intermediate or final phase. This evaluation was carried out by peers who were asked to review or provide feedback for improvement to the designer. In other game-based studies, they also found that collaboration was restricted to gameplaying, rather than game-making.

Findings from this present research study provide strong evidence of collaborative game-making or video game design and building and helps to address the gap in the literature on this strategy. To participate in the learning tasks’ activities, students were grouped into game-design and building teams/groups (story writer, artist, programmer, musician/sound engineer, leader) within which they could utilize a variety of perspectives to collaboratively construct and design their new knowledge/ideas. As the teachers pointed out to their students, without the effective collaboration of groups, it would have become more challenging to complete the tasks’ activities and to effectively learn from the process or this experience. The collaborative nature of the process was most evident in the multiple interaction modes for collaboration and communication (see Figure 21).

The focus of this discussion helped to address the main goal of this research study, attempting to find new ways or innovative pedagogies that could intellectually engage students in deep learning of curriculum content and promote the development and use of 21st century competencies, guided by two questions:

1. In what ways do teachers’ design of instruction and learning tasks need to shift when designing and building digital video games to intellectually engage students in deep learning of curriculum content and to develop and use 21st century competencies in school?
2. In what ways does the design and building of digital video games in school impact students’ intellectual engagement, deep learning of curriculum content and the development and use of 21st century competencies?

In the next chapter, I present some conclusions and practical implications of the findings of this research study for the adoption and implementation of the design and building of digital video games as an innovative pedagogy that could intellectually engage students in deep learning of curriculum content and promote the development and use of 21st century competencies in similar and other school contexts. I also make some recommendations for (i) K-12 educators (teachers and administrators) and (ii) for future research based on further iterations of this intervention in another macro-cycle of the design-based research process.
Chapter 7: Conclusions, Implications and Recommendations

Conclusions

This research study represents a collaborative effort made by a research design team, to carry out or explore an intervention, the design and building of digital video games, in an attempt to address one of the main challenges faced by K-12 educators in some Canadian schools—finding new ways or innovative pedagogies to intellectually engage their students in deep learning of curriculum content as well as promote the development and use of 21st century competencies. The implementation of this intervention took place in one macro-cycle of the design-based research process and guided by two research questions.

The findings emerging from this study indicate that for teachers to effectively implement the intervention in the classroom context, guided by a collaboratively designed framework/model, they needed to shift/modify their design of instructional activities, which impacted the design of the learning tasks’ activities and some of their design principles, more particularly, in the game concept development and storyboarding tasks. Some of the main shifts that were observed include: i) teachers employed more interaction modes to collaborate and communicate during these tasks (see Figure 21); ii) teachers used more extensive coaching and scaffolding (see Figure 22); iii) teachers continuously used various forms of assessments (for, as and of learning) with feedback loops that also reflected the context and the nature of their students (see Figure 23) and which were deliberately developed and adapted as the process continued to assess students’ progress; iv) teachers encouraged more extensive conceptual and divergent thinking to ensure that students/groups were demonstrating their understanding of their chosen topics and not just focused on creating a game; and (v) increased theoretical support for the design of learning tasks’ activities.
Findings also indicate that although about 85% of the students/groups did not complete the first prototypes of their games, the actual learning process through the implementation of the learning tasks mostly had a positive impact on students’ deep learning, intellectual engagement and development and use of 21st century competencies. For instance, a deep learning of the curriculum content, exemplified in students’/groups’ deep understanding of how the citizens in their various models participated in the government decision-making process seemed to be most evident as all students/groups collaboratively brainstormed story ideas, formulated effective questions, researched the curriculum content, discussed, debated, reflected, developed their game concepts and storyboarded them, and while building their game prototypes [emphasis].

Deep learning of role-specific skills and game aspects or game design principles also seemed to be most evident as students/groups storyboarded their game concept ideas. Teachers, however, stated that a deep learning of the curriculum content did not seem as evident in the resulting game prototypes (for examples, see Figures 30 and 32; Appendix O). Overall, the storyboarding task was observed to represent the area of deepest learning of the curriculum content, while the programming task seemed to represent the area of deepest learning about the game aspects or game design principles and the game software/Scratch.

Intellectual engagement seemed to be an inherent feature or by-product of all of the learning tasks. During interviews, about 92% of the students/groups indicated that the activities in the tasks tended to stimulate and sustain their interest, which seemed to be further stimulated by the activities’ relevance to real world situations. Through their role-specific activities, all student/groups indicated that they were highly motivated to complete the storyboarding task, compared to 79% for the programming task. About 83% of the students/groups also indicated that they had experienced the flow state associated with intellectual engagement, while all students/groups indicated that they enjoyed and had fun engaging in all the learning tasks’
activities. Overall, findings from this study indicate that the storyboarding task represented the area of highest intellectual engagement among students.

The development of 21st century competencies also seemed to be an inherent feature or by-product of all the learning tasks. All students seemed to become even more proficient and skilled in all the 21st century competencies as their learning continued through the storyboarding and programming tasks. This helped students to be engaged in the ways in which they will be expected to engage as citizens in a knowledge-building society and in the complex world of work.

In assessing/evaluating and reflecting on the potential and effectiveness of the design and building of digital video games, as implemented in this local context or charter school in Calgary, a discussion of the findings revealed that:

a) The design and building of digital video games does have the potential and appears to qualify as a developing effective innovative pedagogy for deep learning, one that promotes the intellectual engagement of students and their development and application of 21st century competencies. Its potential and/or effectiveness as such was set and analyzed within a contextual framework informed by Fullan and Langworthy’s (2014) core components of new pedagogies for deep learning and the Continuum of New Pedagogies Effectiveness.

b) In comparison to past research findings, the findings from the present research

(i) reveal some significant outcomes that did not seem to appear, or rarely appeared, in the findings of past studies within and outside the formal classroom context (e.g., deep collaboration within and between groups, between teachers and their students and between teachers, emerging roles for teachers and students, more extensive use of coaching and scaffolding, context-dependent authentic
assessments and feedback loops, increased theoretical support for design of instructional and learning activities; see Chapter 6 for more examples);

(ii) help to address concerns identified in past research studies on video game design and building within the formal classroom contexts (e.g., curriculum content in game prototypes more extrinsically than intrinsically integrated, students more interested in designing and building games rather than learning the curriculum content; see Chapter 6 for full discussion);

(iii) appears to begin to address or narrow some gaps in game design-based research (e.g., need for effective innovative pedagogies or participatory learning environments for student intellectual engagement, video game design and building as a context to promote the creation or development of assessments for, as and of learning in the formal classroom context; see Chapter 6 for full discussion).

The findings also reveal that constraints, such as adequate amount of class time, stable time-tabled schedules and relevant resources that are compatible with the game software/Scratch, for example, laptops, posed some challenges to the timely implementation of the learning tasks in a stable knowledge-building space during the process.

**Implications**

A discussion of the findings from this research study has practical implications for K-12 educators (teachers and administrators), school jurisdictions and Alberta Education, in the adoption and implementation of the design and building of digital video games as an innovative pedagogical framework/model in school and by extension, game design-based learning. Specifically, the findings have implications for: (i) effective teaching and learning practice that has the potential to make a positive difference; (ii) the type of theoretical support that may be
needed for the design and building of digital video games as a pedagogical design; (iii) the design of pedagogical frameworks/models that can promote deep learning, intellectual engagement and development of 21st century competencies; (iv) the design and implementation of learning tasks’ activities in the video game design and building context as a collaborative knowledge-building model; (v) the design and implementation of learning tasks’ activities in the video game design and building context as a participatory learning environment; (vi) emerging design principles for learning tasks’ activities as a responsive pedagogy; (vii) curriculum re-design; (viii) implementation of technologies into formal classroom teaching and learning; (ix) significant contribution to the knowledge and research base of game design-based learning, and by extension, game-based learning, in school; (x) the use of design-based research as an effective research approach to study game design-based learning, in school; (xi) policy for the implementation of game design-based learning, and by extension, game-based learning, in school.

Effective Teaching and Learning Practice with Potential to Make a Positive Difference

The findings concerning teachers’ design of the instructional activities and learning tasks have implications for transforming the classroom environment into a place of visible or “effective teaching and deep learning” (Dunleavy & Milton, 2009, p. 18). In such an environment, teachers also need to have high levels of flexibility that allow them to innovate when routines are not enough . . . to ascertain when students are not learning, know where to go next, can adapt resources and strategies to assist students meet worthwhile learning intentions and can recreate or alter the classroom climate to attain these learning goals (Hattie, 2009, p. 246).

The findings from this study reflect what Willms, Friesen and Milton (2009) describe as the activities involved in effective teaching and learning practice:
Teachers used the design and building of digital video games as a thoughtful and intentional design for student learning of the government decision-making process—a learning design that helped to deepen student understanding through genuine inquiry.

Teachers provided the students with work that was relevant, interesting, meaningful and authentic. They also allowed students to see and experience the link between new and emerging technologies and their deep learning of curriculum content.

Effective relationships were built in the classroom or knowledge-building space (see Figure 21). In this space, teachers and their students were involved in robust inquiry, which helped to promote deeper and effective relationships with each other and the discipline. In this relationship, the two teachers scaffolded student learning by providing supports to promote deep learning and active knowledge construction (see Figure 22), resulting in students becoming “more confident learners and knowledge creators” (p. 36).

Teachers intentionally designed assessments (for, as and of learning) into their practice to enable students to think deeply about their own learning (see Figure 23), while equipping them with the skills to become more self-directed learners.

Teachers participated in engaged or collaborative teaching as they frequently thought and planned together, outside of the box, with sustained interaction. They engaged in conversations centered on the work and the curriculum, accessed each other’s knowledge-building space, reflected on their instructional activities based on student performance, resulting in modifications/iterations to the design of their instructional activities and by extension, the learning tasks’ activities. Teachers provided constructive feedback to each other to improve their teaching and actively engaged in
co-constructing ideas that directly contributed to the improvement and development of theirs and student learning.

Observations throughout this study of the teachers’ work with students revealed that teachers used a range of instructional strategies and activities to probe students’ existing knowledge and preconceptions, challenge their ideas and support them in making connections between the curriculum content and real life/world situations. By promoting students’ conceptual and divergent thinking, reflective learning and seeking various modes of problem solving, teachers also informed that robust inquiry in the knowledge-building space and built upon the features of effective teaching and learning practice described by Willms, Friesen and Milton’s (2009).

The re-defining of teachers’ roles to explicitly include teachers as designers of powerful learning experiences, and partners in learning with students (Fullan & Langworthy, 2014), along with students “taking on roles that are pushing the traditional boundaries of learning” (VanderArk & Schneider, 2012, p. 9) during the implementation of the learning tasks, in this study, also has implications for effective teaching and learning practice.

The Theoretical Support Needed for the Design and Building of Digital Video Games as a Pedagogical Design

Theoretically speaking, video game design and building as a pedagogical design requires an interaction between game design theory and learning theories (e.g., situated learning, constructivism, constructionism). In this research study, in addition to situated learning theory, which informed the theoretical framework for the design and implementation of the learning tasks, teachers stated that they also initially drew upon constructivism as the learning theory to support the design of the learning tasks’ activities that guided the actual design and building of students’ video games. However, informed by the design-based research approach, which
dictates that research should “refine both theory and practice” (Collins et al., 2004), the design of the learning tasks’ activities in this first macro-cycle of the DBR process has implications, mostly, for the identification of other possible learning theories that can interact with game design theory to support the design and building of digital video games as a pedagogical design. Some of the possible learning theories that have been identified in this research include, situated learning theory, constructionism, connectivism, assessment theory and scaffolding theory to complement constructivism in supporting instruction and student learning during the design and implementation of the learning tasks or as students/groups designed and built their video games.

It also has implications for practitioners to more actively inform their practice with learning and other supporting theories. When questioned on the learning theories that were informing the design of their instruction and learning tasks’ activities, both teachers took some time (a few minutes) to think about this, and one stated that when planning and designing his teaching and learning activities, he mainly focused on the strategies or techniques that would help student learning and not really the theories that were supporting his strategies.

There still seems to be a need for design theories to clearly define how to design effective digital video games as well as provide the necessary support for their implementation (Watson, 2007). Further iterations of the design and implementation of the learning tasks in this study has implications for the identification and development of these design theories.

**Designing Pedagogical Frameworks/Models to Promote Deep Learning, Intellectual Engagement and Development of 21st Century Competencies**

The framework/model for the actual design, implementation and exploration of the intervention in the prototyping phase of the DBR process, in this present study (see Figure 9), has implications for design frameworks/models that need to be considered for the design, implementation and exploration of video game design and building in similar and other school
contexts to powerfully advance students’ deep learning of curriculum content, and to promote intellectual engagement and continued development and use of 21st century competencies. Depending on the context, the present framework/model may need to be iteratively tested and/or modified to meet the teaching and learning needs of the students in the specified context and discipline.

The Design and Implementation of Learning Tasks’ Activities as a Collaborative Knowledge-Building Model

Scardamalia and Bereiter (2006) identified and discussed six knowledge building principles to illustrate how students participate in the learning process as members of a knowledge building community rather than as individual learners and inquirers:

- “Knowledge advancement as a community rather than individual achievement;
- Knowledge advancement as idea improvement rather than as progress toward true or warranted belief;
- Knowledge *of* in contrast to knowledge *about*;
- Discourse as collaborative problem solving rather than as argumentation;
- Constructive use of authoritative information;
- Understanding as an emergent” (p. 3).

The ways in which the teachers, in this study, designed, redesigned and implemented the learning tasks’ activities, to guide students’ design and building of their video games (see Table 25) tend to reflect Scardamalia and Bereiter’s (2006) knowledge-building principles and can serve as a model for designing and implementing collaborative knowledge-building learning activities in school for effective classroom teaching and learning.
Table 25

**Knowledge-Building Principles in the Design and Implementation of Learning Tasks’ Activities**

<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge advancement as a community rather than individual achievement—authentic creative knowledge work... that substantively advances the state of knowledge in the classroom community and situates it within the larger societal knowledge building effort. One component of knowledge building is the creation of ‘epistemic artifacts’, or tools that contribute to further advancement of knowledge (Sterelny, 2005).</td>
<td>Knowledge advancement in small and large groups to create ‘epistemic artifacts’: game concepts, storyboards and game prototypes, which represented the knowledge building tools and processes to further advance the creation of new knowledge on how the citizens in students’ various models participated in the government decision-making process.</td>
</tr>
<tr>
<td>Knowledge advancement as idea improvement rather than as progress toward true or warranted belief—an explicit principle that guides students’ and teachers’ efforts of (Scardamalia, 2002); use of sustained effort to improve ideas.</td>
<td>Teaching moments, formative assessments (e.g., frequent instructional conversations discussions and/or Socratic dialogues/questioning between teacher participants and student group members, which also involved a great amount of coaching and scaffolding with teacher feedback), along with peer and self-assessments with feedback to build and improve ideas for game concepts and storyboards to inform the building of the game prototypes.</td>
</tr>
<tr>
<td>Knowledge of in contrast to knowledge about—Knowledge about dominates traditional educational practice and consists of all the declarative knowledge about a concept; Knowledge of is acquired through problem solving and implies an ability to do or to participate in the activity of the concept. Discourse as collaborative problem solving rather than as argumentation—the aim is for progress in the state of knowledge, the improvement of ideas and commitment to progress by seeking a common understanding rather than merely agreement to expand the base of accepted facts. It also involves a set of commitments that distinguish it from other types of discourse (Bereiter, 1994, 2002).</td>
<td>Students (in groups) participated in three learning tasks activities—game concept development, storyboarding and programming to create new knowledge of how the citizens in students’ various models participated in the government decision-making process. Frequent discussions and/or Socratic dialogues between teachers and student group members, and peer discussions and assessments (within and across groups), for example, promoted a common understanding of how the citizens in students’ various models participated in the government decision-making process; solved any misconceptions about ideas; and assessed progress.</td>
</tr>
</tbody>
</table>

(table continues)
### Knowledge-Building Principles (Scardamalia & Bereiter, 2006, pp. 4-15)

Constructive use of authoritative information—Various types of authoritative information are valuable, insofar, as they contribute to knowledge building discourse.

Understanding as an emergent—Through the interaction of simpler elements that do not singly or in combination represent the new concept, new conceptual structures tend to emerge; “All understandings are inventions; inventions are emergents” (pp. 14, 15).

### Design and Implementation of Learning Tasks’ Activities

Students, in discussions with their peers and teachers, constructed new and creative ideas (game concepts, storyboards) by negotiating the curriculum content (Smith, 1993) to inform the building of game prototypes.

New conceptual structures (game concepts, storyboards) based on students’ and teachers’ various perspectives and understanding of the government decision-making process in students’ various models emerged.

To further demonstrate how the design and implementation of the learning tasks’ activities can have implications for collaborative knowledge-building models, Figure 50, informed by Stahl’s (2000) knowledge-building processes can also serve as a collaborative knowledge-building model for practitioners as they design and implement knowledge-building activities in school for effective classroom teaching and learning.

![Figure 50. Design and implementation of learning tasks’ activities as a collaborative knowledge-building process informed by Stahl’s (2000) diagram of knowledge-building processes](image-url)
According to the knowledge-building model depicted in Figure 50, the teachers (also as learners) and students enter the knowledge-building process with their initial or tacit personal knowledge and understanding or personal perspectives of the curriculum content and the design and building of digital video games.

They then articulate their personal knowledge and understanding when they enter into an explicitly social process of interaction with each other in small and large group communities with their shared cultures to create new meanings, collaboratively, in the cycle of group knowledge-building and understanding activities. More specifically, in this social knowledge building space, teachers and students participate in a number of interactive activities, such as research, discussions and debates to co-construct new ideas and meanings of the curriculum and other content in each learning task. During this interaction, teachers help to clarify any misconceptions that the students/groups may have about the curriculum content and tasks’ activities as well as ensure a negotiation of theirs and students’ varying perspectives. This results in a shared understanding of the content and tasks’ activities leading to shared collaborative new knowledge or game artifacts.

**The Design and Implementation of Learning Tasks’ Activities as a Participatory Learning Environment**

In this study, teachers’ design, redesign and implementation of the learning tasks’ activities, to guide students’ design and building of their video games also has implications for designing authentic participatory learning environments in the classroom context. Participatory learning is defined as a “collaborative student-centered environment in which students learn from both their peers and teachers using digital media resources and other tools” (Giang, 2013, para. 2). In a participatory learning environment, as described by Jacobsen, Lock and Friesen (2013),
and which was evident as students/groups designed and built their video games during the learning tasks’ activities, teachers are required to:

- balance both structure and openness, to offer flexible boundaries that support and guide learners as they undertake meaningful, challenging and complex collaborative inquiries into enduring ideas and complex questions, problems and issues in a discipline. Teachers communicate standards and expectations to structure the work, brainstorm questions and ideas with students, and provide ample space for student voice, creativity and self-direction in choosing, negotiating and managing their collaborative work. Teachers intentionally design and cultivate learning experiences that engage students’ creativity, imaginations and prior knowledge, and also lead students in appropriate digital citizenship practices and strategies (What are participatory learning environments? section, para. 2).

A participatory learning environment is also immersive, promotes “intellectual rigor, involves substantive conversation” (Willms, Friesen & Milton, 2009, p. 34) and reflects the messiness of the learning process—amidst this noise emanating from groups discovering through research, questioning, debating, discussing, negotiating, taking risks and reconciling diverse interpretations of ideas with peers and their teachers. Reynolds (2015) describes this noise as the actual “sound of natural learning connections—students connecting with each other, with themselves, and with unpredictable possibilities and I add, with their teachers. It was the inevitable chaos associated with expanding learning networks and other emergent systems” (para. 4). This environment also provides a real experience that could connect and prepare learners for the complex world outside the classroom.

**Emerging Design Principles for Learning Tasks’ Activities as a Responsive Pedagogy**

In planning and designing the learning tasks’ activities, teachers used specific design principles to guide the design of the tasks’ activities (see Table 12 and Figure 20). However, as
they implemented the tasks, they realized that they needed to make shifts in the design of some of their instructional activities, which impacted the design of the learning tasks’ activities. These shifts resulted in some emerging design principles to guide the modified design of the tasks’ activities, specifically, teachers:

- designed instruction and learning activities to promote deeper collaboration, communication and interactivity between teachers and content, teachers and technology, teachers and students, student and student, student and group, and group and group;
- designed authentic context-specific assessments to mirror deep learning (for, as and of);
- customized learning activities to fit each learner’s individual way of learning (Tapscott, 2009) through extensive coaching and scaffolding or intense mentoring—this view is supported by Lovelace (2005) who reported that a meta-study of 76 dissertations and other studies have proven that matching the learner’s learning style with complementary learning techniques resulted in improved academic achievement and attitudes towards learning.
- designed learning activities to encourage student intellectual engagement, showing its connections to intelligent behavior (Barab et al., 2012);
- designed learning activities to promote student development and use of 21st century competencies (Binkley, Erstad, Herman, Raizen, Ripley & Rumble, 2010);
- designed learning activities to promote envisionment-building or developing understandings (Fillmore, 1981; Langer, 2012)—dynamic sets of questions, related ideas, anticipations, hunches, images, agreements, rejections, arguments and elaborations that fill individuals’ minds to gain, express and share their thoughts and understandings;
• designed instruction and learning activities to bridge the generational divide between teachers and students—Tapscott (2009) advised that teachers should engage in more interaction with their students and allow them to discover and learn through a “process of critical thinking instead of just memorizing the teacher’s information . . . Net Geners need to learn how to learn, how to look for information, analyze and synthesize it, and critically evaluate the information they find” (pp. 122, 130, 134);
• designed learning activities to intrinsically integrate curriculum content and game elements (Kafai, 2001);
• designed learning activities with more extensive theoretical support.

These emerging design principles have implications for the design and implementation of the learning tasks’ activities in future iterations of these tasks in the video game design and building context.

Curriculum Re-design

Like other school jurisdictions around the world, Alberta Education is exploring a re-design of the provincial curriculum and how to transform students’ learning experiences to better reflect a knowledge-driven, globalized world. As such, Alberta Education is revising provincial programs of study, assessments and learning and teaching resources, as well as processes for developing curriculum, to ensure they continue to be relevant and engaging to students (Alberta Education, 1995-2015).

With the current and ongoing discussions and implementation of a re-design of Alberta’s provincial curriculum, the design and building of digital video games, as implemented in this study, have implications for this curriculum re-design initiative. It appears to model how part of the vision for K-12 education to 2030 can be accomplished. In this vision, Albertans articulated
the following qualities and abilities they wished students to possess, summarised in The Steering Committee Report (2010) as the “Three E’s” of education for the 21st century:

- **Engaged thinker**—“who thinks critically and makes discoveries; who uses technology to learn, innovate, communicate, and discover; who works with multiple perspectives and disciplines to identify problems and find the best solutions; who communicates these ideas to others; and who, as a life-long learner, adapts to change with an attitude of optimism and hope for the future” (pp. 5-6).

- **Ethical citizen**—“who builds relationships based on humility, fairness and open-mindedness; who demonstrates respect, empathy and compassion; and who through teamwork, collaboration and communication contributes fully to the community and the world” (p. 6).

- **Entrepreneurial spirit**—“who creates opportunities and achieves goals through hard work, perseverance and discipline; who strives for excellence and earns success; who explores ideas and challenges the status quo; who is competitive, adaptable and resilient; and who has the confidence to take risks and make bold decisions in the face of adversity” (p. 6).

As students progressively participated in the learning tasks’ activities to design and build their video games, in this research study, the characteristics of all ‘three E’s’ seemed evident. Of the ‘three E’s’, becoming ethical citizens was the most challenging for students as they learned to collaborate within their groups through their assigned roles, to contribute fully to their local community of learning, and by extension, the knowledge society and the world.

As described in The Steering Committee Report (2010), the Alberta education system needs to shift in the following ways to make the inspiring education vision possible:
“The concept of education should expand beyond the school and make the community a true partner”—as a “source of leadership, teaching, and support through the participation of experts, mentors, and elders” (p. 6).

“Children must be the centre of all decisions related to learning and the overall education system” (p. 6) and should be “supported as individuals, emotionally, intellectually, physically, socially and spiritually. Their personal interests, curiosities, and strengths should be taken into account and activities that encourage play, creativity and imagination should become the norm” (p. 6). The “curriculum should be relevant and available in a variety of forms” and must be made “accessible to all students virtually or in-person, collaboratively or independently, and at each student’s own pace” (p. 6).

By 2030, the educated Albertan “should develop and demonstrate the attitudes, skills, knowledge, and values required for life-long learning”—“competencies that would move education to a process of inquiry and discovery [deep learning] and not just the dissemination of information and recall of facts [surface learning]” (pp. 6-7). Learners would “focus more deeply on a curriculum that allows for more interdisciplinary learning, combining the arts and other academic streams” (p. 7).

Assessment should also change to “measure core competencies”—“need for diverse approaches to evaluate learner competency, including the use of qualitative measures” (p. 7).

Teachers’ roles should change “from that of knowledge authority” (p. 7) to architects of learning—those who plan, design and oversee learning activities, “consider the interests, passions, talents and natural curiosities of the learner [and] inspire, motivate and plant the seeds for life-long learning” (p. 7).
- Meaningful professional development for teachers to assure teaching excellence needs to change to align with the shifts in policy—“teachers need to be innovative, passionate and positive about teaching” (p. 7).

- “Technology should play a broader role in the classroom”—“used as a tool [and process] to impart information, in support of learners’ innovation and discovery [and] be seamlessly integrated into the learning environment” (p. 7).

With the exception of making the community as a true partner, this first cycle of teachers’ implementation of the design and building of digital video games in the classroom context, demonstrated these shifts and has implications for incorporating all these shifts in the classroom, and by extension, in the school context.

**Implementation of Technologies into Formal Classroom Teaching and Learning**

Daniels, Jacobsen, Varnhagen and Friesen (2013) noted that in K-12 environments, funding is provided for purchasing various types of technologies to promote major technology initiatives in the hopes of providing transformational experiences to students. However, many of these initiatives often seem to consist of trying to place as much technology as possible in schools in the hope that teachers and students will derive some benefits from the technology simply by its addition (OECD, 2010). Christensen, Horn and Johnson (2008) has described the schools’ implementation of these technology initiatives as a “crammed” (p. 12) addition to the existing structure rather than allowing the disruptive technology to take root in a new model. As a result, the expected benefits of using these technological initiatives in the classroom are not always evident (Cuban, 2006).

For instance, in their research on *Barriers to Systemic, Effective, and Sustainable Technology Use in High School Classrooms*, Daniels, Jacobsen, Varnhagen and Friesen (2013) reported that they “saw little evidence of technology being used in support of increased student
engagement through teachers’ use of innovative instructional strategies or practices” (p. 4) in
classrooms where teachers were using technology. Instead, teachers were selecting and
controlling the technology and the content. Related to these findings, Dede (2014) noted that, to
date, technologies or digital tools and media “have mainly been used to automate conventional
models of teaching, as though the goal were to continue pursuing a narrow set of learning goals
related to preparation for an industrial economy” (p. 5). For instance, he pointed out that

Electronic whiteboards and digitized videos are used primarily to present information.
And in one-device per-student initiatives, laptops, tablets, and cell phones are generally
used as delivery platforms for traditional instruction, rather than as means by which to
empower students and engage them in deeper learning (p. 5).

Dede (2014) further explained that “the real value in technology for teaching lies in
rethinking the enterprise of schooling in ways that unlock powerful learning opportunities” that
prepare “students to be more responsive to the opportunities and challenges of a global,
knowledge-based, innovation-centered civilization” (p. 5). As they participated in the learning
tasks’ activities in this present research study, the ways in which teachers and students modeled
the effective use of various technologies to enhance a deep learning of the chosen social studies
curriculum content have implications for using technologies to unlock powerful learning
opportunities for both teachers and their students. This also has implications for modelling the
exploration and implementation of emerging technologies and other exciting ways to disruptively
enhance the teaching and learning experience in the classroom.

**Significant Contribution to the Knowledge and Research Base of Game Design-Based Learning**

In this research study, the findings resulting from the implementation and exploration of
the design and building of digital video games in the classroom context has implications for
making a significant contribution to the knowledge and research base of game design-based learning, and by extension, game-based learning in school. For instance, the findings can inform:

- development and implementation decisions for gaming environments in the classroom context;
- research which indicate that digital video games (play-based and design-based) are an ideal medium to promote authentic learning (Mims, 2003) and ‘learning by doing’ (Lombardi, 2007) processes because it is through ‘doing things’ that students develop conceptual understanding (Dunleavy & Milton, 2009).
- the intrinsic integration (Kafai, 2001) of core curriculum content into the gaming environment;
- an understanding of pedagogical issues in game design-based learning;
- how new modes of learning significantly change factors, such as classroom management, the pace of learning, teacher control and the teacher–learner relationship (BECTA, 2008);
- approaches that make the learning experience interesting and intellectually engaging for the learner;
- rich, embodied and collaborative interactions in which learners think with complex tools and resources in complex problem-solving situations (Gee, 2003);
- interaction with a more user-friendly environment which allows learners a greater level of involvement and creativity and increases social interactions and active engagement (Murugesan, 2007);
- factors that impact the use of game-based learning in schools (Futurelab, 2010);
- processes or techniques by which teachers can plan and introduce game-based learning into the curriculum (Futurelab, 2010);
recommendations for future game-based learning approaches in schools (Futurelab, 2010).

The Use of Design-Based Research as an Effective Research Approach to Study Game Design-Based Learning

Using the design-based research approach to implement the design and building of digital video games in the classroom context has implications for the types of research approaches that are most effective to study how game design-based learning, and by extension, game-based learning can help to create more visible, relevant, interesting, engaging and authentic teaching and learning experiences in school. Design-based research “calls for iterative cycles of study that lead to a better understanding of the process of intervention—process oriented” (Amiel & Reeves, 2008, p. 35). It is “a commitment to understanding learning and instruction in authentic contexts . . . and provides a useful framework for studying learning in existing classrooms” (Squire, 2005, p. 11).

Design-based research can help to reveal what, how, when, and why an intervention works through an iterative design process. All these are very important questions that need to be answered when implementing interventions that aim to transform teaching and learning in the classroom into more visible, relevant, engaging, interesting and authentic experiences that will meet the learning needs of both teachers and their students. Answering these questions can also be relevant for future iteration/refinement of the interventions for possible long-term effectiveness and impact into similar and other school contexts.

Policy for the Implementation of Game Design-Based Learning in School

In this research study, the design and building of digital video games, as implemented and explored in the classroom context has implications for the development of policy to inform:
the sustainable implementation of the design and building of digital video games as an innovative pedagogical design or new learning system that will “foster sustainable change across whole systems to achieve deep learning aims” (Fullan & Langworthy, 2014, p. iii);

the professional development of teachers to ensure that they have the knowledge, skills, space, time and administrative support to become confident pedagogical innovators with new technologies (BECTA, 2008);

the professional development of school leaders (administrators, principals, professional development leaders, and so on) to ensure that they embrace technological change and participate in the integration of technology into formal classroom teaching and learning as well as address concerns about e-safety, logistics and sustainability;

the integration of new and emerging technologies or technology-enabled environments or engaging, collaborative and productive learning environments into current curriculum and assessment framework;

the provision of adequate resources for relevant, effective and successful technology-enabled learning environments;

the development of solutions to technical and logistical issues (cost, licensing, limitations of school computers, technical support) to make game design-based learning and by extension, game-based learning and other new and emerging technologies part of the fabric of the K-12 curriculum.
Recommendations

Based on the findings and implications of this research study, some practical recommendations become evident for (a) K-12 educators (teachers and administrators), school jurisdictions and (b) for further research.

Recommendations for K-12 Educators and School Jurisdictions

In light of one of the main challenges faced by K-12 educators in some Canadian schools about finding new ways or innovative pedagogies to intellectually engage their students in deep learning of curriculum content, while also promoting the development of 21st century competencies in the classroom context, it became evident from the findings of this study that the design and building of digital video games strongly qualifies as one of these new ways or innovative pedagogies worth adopting to address this challenge. Based on the findings, the following recommendations are, therefore, suggested for its adoption and implementation in school, along with other emerging technologies to enhance the teaching and learning experience in today’s classroom and beyond:

 When making decisions to adopt and implement new ways or technologies for a more visible, relevant, engaging, interesting and authentic teaching and learning experience in the classroom, teachers should first immerse themselves in collaborative research pursuits, such as design-based research, that encourage their exploration with these new ways or technologies in classroom teaching and learning.

 When making decisions to adopt and implement these new ways or technologies, teachers should make these decisions collaboratively with peers within a community of practice. This type of teacher collaboration and co-learning can encourage more engaged teaching experiences within and across disciplines, which is strongly needed
for successful implementation of new initiatives in the classroom. Making these decisions about innovations in practice without peer support or collaboration may lead to frustration, burnout and eventual abandonment of the initiative or intervention.

- When making decisions to adopt and implement new ways or technologies as part of the fabric of the curriculum, teachers should continuously collaborate with their administration to ensure that they receive full administrative support in terms of solutions to technical and logistical issues (timetabling, cost, licensing, limitations of school computers, technical support).

- When making decisions to adopt and implement new ways or technologies in the classroom, teachers should collaboratively identify and work out possible contingencies for contextual constraints that can pose challenges to their successful adoption and implementation, such as flexible school activities that can disrupt timetables, timing, knowledge-building space and relevant resources. In this study, although teachers were aware of contextual constraints, such as the flexibility of the school’s activities, no contingency plan was made to address it. The lack of a contingency plan did impact the amount of class time that could have been scheduled for the implementation of the learning tasks.

- When planning to adopt and implement technologies, ensure that adequate and relevant resources are available and accessible to students in the classroom or knowledge-building space. Resources in remote knowledge-building spaces can pose challenges to student participation in their activities, leading to disruptions that could negatively impact their learning experience and prolong the amount of class time needed, as was seen in this research study.
When planning to adopt the design and building of digital video games, for example, ensure that some of the resources also include a variety of game software that students can choose from and a variety of games that they can play to become more familiar with game design principles in various game genres. Experimenting with other game design software within this framework will help teachers and students discover which ones work best in the various contexts and disciplines. Other possible game building software may include: Kodu, GameMaker, Gamestar Mechanic, RPG Maker and Unity—a cross platform, professional 3D game engine that allows users to create realistic 3D games.

Teachers continuously used formative assessments with feedback loops during the game concept development and storyboarding tasks to monitor students’ progress in their deep learning of the curriculum content as they designed their video games. Further research on how to effectively use progress monitoring (McMaster & Wagner, 2007) as a method to determine whether students are making adequate progress in their learning is recommended to inform the effectiveness of this and other interventions for more visible, relevant, interesting, engaging and authentic teaching and learning in today’s classroom and beyond.

**Recommendations for Further Research**

It is expected that the findings and their implications in this design-based research study will lead to a clearer understanding of (i) how, when and why the teachers, in collaboration with a design-based researcher, implemented the design and building of digital video games as an intervention to intellectually engage students in deep learning of curriculum content and to develop and use 21st century competencies in school; (ii) the possible benefits of this research to
21st century education and beyond; and (iii) some of the challenges that may be encountered during the implementation of this type of intervention.

Based on the findings and implications resulting from the implementation and exploration of the design and building of digital video games in the classroom context, in this research study, the following are recommendations for further research:

- Design-based research is theory-driven and dictates that research should “refine both theory and practice” (Collins et al., 2004). In terms of refining practice, this was evident during the implementation of the learning tasks in this research study. Although other theories, not initially identified, were identified that described and explained innovations practice, theory refinement was not as evident in this shorter term study because, as explained by Amiel and Reeves (2008), “this might only occur after long-term engagement and multiple design investigations” (p. 35). Therefore, for theory development and refinement to support practice in the design and building of digital video games, further research involving the design and implementation of the intervention in more meso-cycles of the prototyping phase of the DBR process will be needed.

- As the teachers collaboratively implemented the intervention in the prototyping phase of the DBR process, a modified designed framework/model emerged (see Figure 9), resulting from the required changes/modifications that teachers needed to make to instructional and learning tasks’ activities in order to move the process forward (as described in Chapter 4). In future research, this designed framework/model will need to be tested in similar and other contexts and/or disciplines to validate its usability and long-term effectiveness and impact. During these tests, there may be a need for further iterations or modifications to the design and its implementation depending on the
discipline and/or context in which it will be implemented. To track the number of iterations or modifications needed for its successful design and implementation into these various contexts and/or disciplines, longitudinal data will be collected, analyzed and reported.

- A framework informed by Fullan and Langworthy’s (2014) core components of new pedagogies for deep learning and the Continuum of New Pedagogies Effectiveness was used to assess/evaluate and reflect on the effectiveness of the design and building of digital video games as an innovative pedagogy for deep learning. Based on the result of this assessment/evaluation and reflection, the design and building of digital video games successfully met the requirements for the core components, but was also found to be mostly located in the development stage on Fullan and Langworthy’s (2014) Continuum of New Pedagogies Effectiveness. To locate the design and building of digital video games as an innovative pedagogy for deep learning in the more advanced stage of the Continuum, further research, involving its design and implementation in more meso-cycles of the prototyping phase of the DBR process will be needed.

- There is still some concern, both in this present and past research, about the pedagogical usability of the design and building of digital video games in schools. In this research study, for instance, there were some challenges to the ‘when’ and some aspects of the ‘how’ during the implementation of the learning tasks’ activities as students/groups designed and built their video games. Tzuo, et al. (2012) also noted that “No matter how game design has been greatly developed in order to enhance students’ learning, its pedagogical usability to school implementations, including why, when, and how to use it is still ambiguous and not consolidated yet” (p. 420). As far back as 1994, Nielsen (1994) also noted the growing concern about the effective adoption of the game design-
based learning approach in the school context because of the possible contextual and practical constraints of the school setting. Further research will need to be carried out with contingency plans, in place, to address all these and other possible constraints to the implementation of the design and building of digital video games in school.

- Further research is called for to discover why some of the school-based constraints on the design and building of digital video games continue to exist despite the contingencies implemented.

- In analyzing the collected data to assess/evaluate and reflect on the potential and effectiveness of the design and building of digital video games as an innovative pedagogy that can also address the problem that initiated this research study, more qualitative measures were used. However, in future research, more quantifiable methods to measure the impact of the design and building of digital video games on deep learning, intellectual engagement and development and use of 21st century competencies will be needed to support the qualitative measures and for deeper interpretation of the data.

- During the implementation of the three learning tasks, findings indicated that there seemed to be an interplay of deep learning, intellectual engagement and development and use of 21st century competencies. Further research, using more quantifiable methods will be needed to carry out a correlative analysis of this relationship in the game design and building context to determine the nature of that relationship and how that context specifically contributes to this relationship.

- With the continued debate into the impact of gender on the design and building of video games, within and beyond the school context, the findings from this present research study can contribute to future research into this impact.
- The design-based research process closely reflects the instructional design ADDIE model: Analysis, Design, Development, Implementation, and Evaluation. Further research is called for into this relationship to understand the transformation of teachers’ roles from traditional instructional designers to that of learning designers through design-based research (Seeto & Herrington, 2006).

- Additional research of the kind enacted in this design-based research study will provide opportunities for new and continued conversations on the successful adoption and implementation of the design and building of digital video games and other emerging technologies in school. These conversations will also need to focus on the contextual and practical constraints of the school setting and how they can be modified for successful adoption and impact for a more visible, engaging, interesting, relevant and authentic teaching and learning experience in the classroom.

At the end of this first macro-cycle of this DBR study, findings revealed that the design and building of digital video games does have the potential and seem to qualify as a developing effective innovative pedagogy to intellectually engage today’s students in deep learning of curriculum content and to also promote the development and use of 21st century competencies—thereby, helping to address one of the main challenges faced by K-12 educators in some Canadian schools. Designing and building digital video games does represent one of the ways in which students indicated they want to learn, in school; it reflects the type of learning environment that students enjoy and are using outside the formal classroom context in “creative, entertaining and collaborative ways” (Jacobsen, 2010, A shifting Digital World section, para. 3).

The design and building of digital video games also models learning environments that provide for comprehensive and continuous work with ideas and practices that disrupt the established assumptions about teaching, learning and educational outcomes (Dunleavy & Milton,
2009). The findings of this study and their implications will make a significant contribution to the knowledge and research base of game design-based learning in school, the learning sciences and the systematic change needed in the education system to make teaching and learning more visible, relevant, interesting, engaging and authentic for a more connected and complex world.
References


Putting it into practice. Maidenhead, Open University Press.


342


Robert Wood Johnson Foundation.


Instructional Technology Ph. D students at the University of Georgia. (2006c). What are the challenges of doing DBR? Retrieved from http://projects.coe.uga.edu/dbr/enact03.htm#first


*Performance Improvement Quarterly, 21*(2), 7–36.


University of Alberta and University of Lethbridge, (n.d.). Literature synopsis: Authentic assessment. Retrieved from

University of Calgary Conjoint Faculties Research Ethics Board. (2012). Retrieved from
http://www.ucalgary.ca/research/ethics/CORE_Tutorial


372


373
### Twenty-first Century Competencies and Specific Skills

<table>
<thead>
<tr>
<th>Twenty-first Century Competencies</th>
<th>Specific Skills</th>
</tr>
</thead>
<tbody>
<tr>
<td>Creativity and Innovation</td>
<td>“Thinking creatively by creating new and worthwhile ideas; being able to elaborate, refine, analyze and evaluate their own ideas in order to improve and maximize creative efforts; working creatively with others; and developing, implementing and communicating new ideas to others effectively” (p. 16).</td>
</tr>
<tr>
<td>Critical Thinking, Problem Solving and Decision-Making</td>
<td>“Reasoning effectively by using various types of reasoning (inductive, deductive, etc.) as appropriate to the situation; using systems thinking by analyzing how parts of a whole interact with each other to produce overall outcomes in complex systems; examining ideas by identifying and analyzing arguments; synthesizing and making connections between information and arguments; interpreting information and drawing conclusions based on the best analysis; categorizing, decoding and clarifying information; effectively analyzing and evaluating evidence, arguments, claims and beliefs; analyzing and evaluate other points of view; evaluating and assessing claims and arguments; solving problems by being open to non-familiar, unconventional and innovative solutions to problems and to ways to solve problems and asking meaningful questions that clarify various points of view and lead to better solutions; making reasoned judgments and decisions by considering and evaluating major alternative points of view, reflecting critically on learning experiences and processes and incorporating these reflections into the decision-making process” (p. 18).</td>
</tr>
<tr>
<td>Communication</td>
<td>“Demonstrating ability to communicate, in written or oral form, and understand, or make others understand, various messages in a variety of situations and for different purposes; demonstrating ability to formulate arguments, in speaking or writing, in a convincing manner and take full account of other viewpoints, whether expressed in written or oral form” (p. 22).</td>
</tr>
<tr>
<td>Collaboration and teamwork</td>
<td>“Interacting effectively with others; speaking with clarity and awareness of audience and purpose; listening with care, patience and honesty; conducting themselves in a respectable, professional manner; working effectively in diverse teams; leveraging social and cultural differences to create new ideas and increase both innovation and quality of work; managing projects by prioritizing, planning and managing work to achieve the intended group result; guiding and leading others by using interpersonal and problem-solving skills to influence and guide others toward a goal; leveraging the strengths of others to accomplish a common goal; inspiring others to reach their very best via example and selflessness; demonstrating integrity and ethical behavior in using influence and power” (p. 23).</td>
</tr>
</tbody>
</table>

(table continues)
<table>
<thead>
<tr>
<th>Twenty-first Century Competencies</th>
<th>Specific Skills</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Information literacy</strong></td>
<td>“Accessing and evaluating information by demonstrating ability to search, collect and process electronic information, data and concepts and using them in a systematic way; using and managing information by demonstrating ability to access and search a range of information media including the printed word, video and websites and to use internet-based services; demonstrating ability to use information to support critical thinking, creativity and innovation in different contexts; demonstrating ability to search, collect and process written information, data and concepts in order to use them in study and to organize knowledge in a systematic way; demonstrating ability to distinguish, in listening, speaking, reading and writing, relevant from irrelevant information” (p. 25).</td>
</tr>
<tr>
<td><strong>Living in the World- Life and career</strong></td>
<td>“Adapting to change; operating in varied roles, jobs responsibilities, schedules and contexts; being flexible; incorporating feedback effectively; negotiating and balancing diverse views and beliefs to reach workable solutions; managing goals and time; setting goals with tangible and intangible success criteria; balancing tactical (short-term) and strategic (long-term) goals; utilizing time and managing workload efficiently; working independently; monitoring, defining, prioritizing and completing tasks without direct oversight; interacting effectively with others; knowing when it is appropriate to listen and when to speak; working effectively in diverse teams; leveraging social and cultural differences to create new ideas and increasing both innovation and quality of work; managing projects; setting and meeting goals; prioritizing, planning and managing work to achieve the intended result even in the face of obstacles and competing pressures; guiding and leading others; using interpersonal and problem solving skills to influence and guide others toward a goal; leveraging strengths of others to accomplish a common goal; inspiring others to reach their very best via example and selflessness; demonstrating integrity and ethical behavior in using influence and power” (p. 32).</td>
</tr>
<tr>
<td><strong>Living in the World- Citizenship – local and global</strong></td>
<td>“Participating in community/neighborhood activities as well as in decision-making at national and international levels; voting in elections; displaying solidarity by showing an interest in and helping to solve problems affecting the local or the wider community; interfacing effectively with institutions in the public domain; profiting from the opportunities given by the home country and international programs” (p. 30).</td>
</tr>
</tbody>
</table>

*Binkley, Erstad, Herman, Raizen, Ripley & Rumble. (2010). Draft white paper 1: Defining 21st century skills*
Table 3

Game Design Principles: Specific Details of Embedded Educational Characteristics of Gaming, Learning and Technical Aspects

<table>
<thead>
<tr>
<th>Educational Characteristics in Gaming Aspects</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Goals</strong></td>
<td>The goals and objectives that the player will have to accomplish in order to complete the game should be clearly presented.</td>
</tr>
<tr>
<td><strong>Rules</strong></td>
<td>The game’s rules should be clear and consistent along the whole game. This will help players achieve the goals and objectives they have to accomplish in order to successfully complete the game.</td>
</tr>
<tr>
<td><strong>Challenge</strong></td>
<td>The player should be continuously challenged to strive for continuous improvement. This can be achieved by an increasing level of difficulty throughout the game. However, to avoid discouraging the player, the level of challenge should not surpass the level of possibilities.</td>
</tr>
<tr>
<td><strong>Rewarding system/short feedback cycle</strong></td>
<td>Players should be able to perceive the impact and consequences that their actions have in the game world, in order to be informed on how they are performing, check their progress continuously, and enable them to eventually adjust their actions. Positive feedback is often associated with rewards, which help the player to achieve the objectives and act as a mechanism to increase engagement and immersion.</td>
</tr>
<tr>
<td><strong>Engagement/immersion</strong></td>
<td>The game should engage the player, which can be achieved through different techniques: interesting plot/story, appealing environment/virtual world, contextualization, challenging goals, etc. Immersion is a good way to stimulate the player’s engagement into the game.</td>
</tr>
<tr>
<td><strong>Adaptability/flexibility</strong></td>
<td>The game experience should vary from one player to another and between different game runs. Adaptability is often achieved by varying the challenge depending on the player’s skills and knowledge.</td>
</tr>
<tr>
<td><strong>Re-playability</strong></td>
<td>The player should be able to play the game more than once. Re-playability is a result of a good design and an appropriate balance of characteristics such as adaptability (presenting different challenges each time) and engagement.</td>
</tr>
<tr>
<td><strong>Competition/collaboration</strong></td>
<td>The game scenario should promote ‘good’ competition and collaboration. Competition could happen between peers and could also be self-competition, through game scoring or ranking systems. Collaboration could be between peers playing the same game, but could also happen outside the game with players discussing the game’s strategies/solutions either face to face or online.</td>
</tr>
<tr>
<td><strong>Entertainment</strong></td>
<td>The game should provide entertainment to the user.</td>
</tr>
<tr>
<td>Educational Characteristics in Learning Aspects</td>
<td>Description</td>
</tr>
<tr>
<td>-----------------------------------------------</td>
<td>-------------</td>
</tr>
<tr>
<td><strong>Educational objectives</strong></td>
<td>Clear educational objectives should be predefined so that the educational affordances of the game would allow the students to achieve these objectives.</td>
</tr>
<tr>
<td><strong>Students’ profile</strong></td>
<td>The students’ age/skills/knowledge level/socio-cultural profile should be taken into consideration when designing the learning scenario and the game.</td>
</tr>
<tr>
<td><strong>Learning resources</strong></td>
<td>The game should provide internally or as links, relevant learning resources which are necessary for achieving the educational objectives.</td>
</tr>
<tr>
<td><strong>Evaluation methodologies</strong></td>
<td>The learning scenario should consider a specific evaluation methodology. In the game-based learning scenario, this evaluation method might drastically differ for traditional approaches, such as tests or exams. In game-based learning, the rewarding system could be adapted to evaluate the players’ performance within the game. This approach is much less invasive, in the sense that students might not be aware of the pedagogical evaluation process, but only aiming to achieve the game objectives. This approach is especially suitable for reaching less performing students. Furthermore, game-based learning allows for implementing immediate feedback systems, which might help learners to check their progress continuously.</td>
</tr>
<tr>
<td><strong>Comprehensive learning scenario</strong></td>
<td>The game-based learning scenario might be embedded in a predefined wider learning scenario which might include other learning activities (for example, further discussion/reflection session in the classroom, group activities, reports, presentations and practice outside the classroom).</td>
</tr>
<tr>
<td><strong>Progressive acquisition of knowledge</strong></td>
<td>At any point of the game-based learning scenario, the level of challenge of the learning experience should be high enough to keep students engaged and motivated but without surpassing their abilities so they do not become frustrated.</td>
</tr>
<tr>
<td><strong>Personalization</strong></td>
<td>The game might provide a personalized learning process according to the students’ profile, which might include the student’s age, previous knowledge, speed of knowledge acquisition and skills.</td>
</tr>
<tr>
<td><strong>Level of autonomy of the learner</strong></td>
<td>This factor should be predefined and depend on the educational context. Game-based learning environments usually promote the autonomy of learners, who are free to explore the game without the requirement of an intervention by an instructor.</td>
</tr>
</tbody>
</table>
### Educational Characteristics in Learning Aspects

| Motivation | Students’ motivation to employ them in the learning activity constitutes a critical factor for achieving the educational objectives. The motivation would depend on a good combination of the above listed factors and on balancing between the educational and gaming aspects. Motivation, here, will be grounded in Csikszentmihalyi’s (1990) Flow Theory to provide enjoyment or pleasure in the game design and building activities. Csikszentmihalyi identifies the following characteristics of flow that are consistent with effective games: there are clear goals every step of the way, immediate feedback to the player’s actions, a balance between challenges and skills, action and awareness are merged, distractions are excluded from consciousness, no concern about failure, self-consciousness disappears, the sense of time becomes distorted and the activity becomes ‘autotelic’—it is an end in itself (Rieber, 1996). |

### Educational Characteristics of Technical Aspects

| Usability | The game should be easy to use so that the player can concentrate on the objectives set within the game without frustration. The game functionalities should be easy to learn. There should be clarity in the interactions, and the navigation should not present any errors. In order to assist the player, the game might include, if necessary, a user guide or any additional help. |
| Well-designed graphics | The visual aspects of the game should be attractive in order to engage users. Moreover, certain scenarios might require a high level of realism. Such attractiveness could be reached whether by using high quality graphical elements or by employing familiar objects. |
| Re-usability | As a consequence of their adaptation potential, games present a high level of re-usability, defined as the potential to be used in different contexts without the need of complex and costly modifications to suit particular groups. This characteristic makes games attractive as learning tools as it helps to reduce costs by increasing the amortization of the initial investment. (pp. 20–22) |

*Adapted from Mellini, Talamo & Giorgi’s (2010) Educational Characteristics of Gaming, Learning and Technical Aspects*
Appendix C

Scratch

Scratch Interface

Scratch videos downloaded from YouTube

1. What is Scratch?
   https://www.youtube.com/watch?v=nLEteUAZRI8

2. An Introduction to the Scratch Programming Language for Education
   https://www.youtube.com/watch?v=4y6J2jXjU34

3. Signing into Scratch
   http://scratch.mit.edu/

4. Authoring Environment
   User Interface
   https://www.youtube.com/watch?v=kB53lT8vVJo

   Sprite: Part 1
   https://www.youtube.com/watch?v=zcSgcAcA6Vc

   Sprite: Part 2
   https://www.youtube.com/watch?v=K655nUifr3o

   Backdrop: Part 1
   https://www.youtube.com/watch?v=5WtEA92K6g0

   Backdrop: Part 2
   https://www.youtube.com/watch?v=x8Ng-NCAG_U

   Paint Editor
   https://www.youtube.com/watch?v=p6F4LxzuF9Y

   Backpack
   https://www.youtube.com/watch?v=nQ8UrAhht4I
5. **Blocks and Concepts**

Sequences
https://www.youtube.com/watch?v=pKgWqFVbUrU

Motion: Part 1
https://www.youtube.com/watch?v=n2hkZP06tyI

Motion: Part 2
https://www.youtube.com/watch?v=w8RixZ8kIA

Loops
https://www.youtube.com/watch?v=yRe1c2qvZDA

Events
https://www.youtube.com/watch?v=FUMFPhihAbc

Parallelism
https://www.youtube.com/watch?v=Y3CO_qkTyI8

Looks: Part 1
https://www.youtube.com/watch?v=1temBzBAgvQ

Looks: Part 2
https://www.youtube.com/watch?v=l5kPQy4cYU0

Switching Costumes
https://www.youtube.com/watch?v=3oWi8XhJVqE

Switching Backdrops
https://www.youtube.com/watch?v=G1CGmh1sspM

Sound
https://www.youtube.com/watch?v=P40Y72QSSmI

Sound Editor
https://www.youtube.com/watch?v=Je8QM_hYWl0

Conditionals
https://www.youtube.com/watch?v=CFy3qGw94N0

Control: Part 1
https://www.youtube.com/watch?v=CKpu1q53cSM

Control: Part 2
https://www.youtube.com/watch?v=gOkgiHZUHqc

Sensing: Part 1
https://www.youtube.com/watch?v=R UmaUIDn3yI
Sensing: Part 2  
https://www.youtube.com/watch?v=IzkjPB0Zf0c

Broadcasting  
https://www.youtube.com/watch?v=MCymzSTse5o

Operators: Part 1  
https://www.youtube.com/watch?v=XHNBZvAcyhs

Operators: Part 2  
https://www.youtube.com/watch?v=AEVQLC5pLqs

Cloning  
https://www.youtube.com/watch?v=Jnh98VtTWO8

Pen  
https://www.youtube.com/watch?v=h-hbSsJWPsc

Variables  
https://www.youtube.com/watch?v=uXq379XkhVw

Lists  
https://www.youtube.com/watch?v=I0Gj_1SqOao

Cloud Variables  
https://www.youtube.com/watch?v=DKKSyWuRGjY

Make A Block  
https://www.youtube.com/watch?v=-q5vYECKNek

6. Other tutorials
Scratch Background Scrolling Tutorial  
http://www.youtube.com/watch?v=KHcTRzaB2Hg

Scratch Tutorial - Making Backgrounds  
http://www.youtube.com/watch?v=9LNFvYfS_Zk

MIT Scratch Tutorial - Changing and Animating Backgrounds  
http://www.youtube.com/watch?v=gpAO6wMkNXk

Scratch Car Race Part 1  
http://www.youtube.com/watch?v=DjmrpIL7Kwo

7. Additional website for Scratch training sessions  
http:// pluralsight.com/training/Courses/TableOfContents/ learning-programming-scratch
Appendix D

Video Game Experience Survey

Instructions: Complete the following survey on your experience with video games.

1. **Do you play computer video games?**
   - Yes
   - No

2. **Do you build computer video games?**
   - Yes
   - No

3. **How many hours do you play video games during an average week?**
   - 0 hours
   - 0-3 hours
   - 3-6 hours
   - 6-9 hours
   - 9-12 hours
   - 12+ hours
4. How many hours do you take to build video games during an average week?

- 0 hours
- 0-3 hours
- 3-6 hours
- 6-9 hours
- 9-12 hours
- 12+ hours

5. Which computer video games do you play?

_________________________  _______________________

_________________________  _______________________

_________________________  _______________________

_________________________  _______________________

_________________________  _______________________

6. Which software do you use to build your video games?

_________________________  _______________________

_________________________  _______________________

_________________________  _______________________

_________________________  _______________________

_________________________  _______________________

383
7. Do you perform other tasks while playing or building games (e.g. chatting, reading, blogging, etc.)?
   - Yes
   - No

8. Do you have a community of friends, online or offline that originated from playing and/or building video games?
   - Yes
   - No

9. Has playing and/or building video games taken priority over other activities? (e.g. doing homework, studying for a test, preparing lesson plans, etc.)?
   - Yes
   - No

Thank you for taking this survey!

Name: .................................................................

Gender: ...........................................

Adapted from Survey Monkey @ http://www.surveymonkey.com/s/G9F3F6S
# Results of the Video Game Experience Survey

## Response to Survey on Video Game Experience

### Grade 6.1

<table>
<thead>
<tr>
<th>Initials</th>
<th>Play</th>
<th>Build</th>
<th>No. of hours play</th>
<th>No. of hours build</th>
<th>Games play/played</th>
<th>Software used to build</th>
<th>Perform other tasks</th>
<th>Playing/building as priority</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Male</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TN</td>
<td></td>
<td></td>
<td>3-6</td>
<td>0</td>
<td>Spore, Ksp</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AB</td>
<td></td>
<td></td>
<td>3-6</td>
<td>0</td>
<td>Injustice</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>KE</td>
<td></td>
<td></td>
<td>6-9</td>
<td>0</td>
<td>Minecraft, Injustice, Xbox, Wii</td>
<td>Chatting, reading, blogging</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MB</td>
<td></td>
<td></td>
<td>3-6</td>
<td>0</td>
<td>Minecraft</td>
<td>Chatting, reading, blogging</td>
<td></td>
<td>Doing homework, studying for a test</td>
</tr>
<tr>
<td>VN</td>
<td></td>
<td></td>
<td>3-6</td>
<td>0</td>
<td>Call of duty, Black ops, Injustice, Happy Wheels, League of Legends, Modern Warfare 2</td>
<td>Chatting, reading, blogging</td>
<td></td>
<td></td>
</tr>
<tr>
<td>WM</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OD</td>
<td></td>
<td></td>
<td>6-9</td>
<td>0</td>
<td>Fifa soccer, racing, shooting games</td>
<td>Chatting, reading, blogging</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NY</td>
<td></td>
<td></td>
<td>12+</td>
<td>0</td>
<td>Call of duty</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Female</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GT</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WP</td>
<td></td>
<td></td>
<td>12+</td>
<td>0</td>
<td>Minecraft, Fortress2</td>
<td>Chatting, reading, blogging</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AM</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GC</td>
<td></td>
<td></td>
<td>3-6</td>
<td>0</td>
<td>Call of duty, Black ops, Injustice</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LT</td>
<td></td>
<td></td>
<td>3-6</td>
<td>0</td>
<td>TF2</td>
<td></td>
<td></td>
<td>Doing homework, studying for a test</td>
</tr>
<tr>
<td>EB</td>
<td></td>
<td></td>
<td>3-6</td>
<td>0</td>
<td>Injustice, minion rash</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LG</td>
<td></td>
<td></td>
<td>3-6</td>
<td>0</td>
<td>Sports video games</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

385
<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>HM</td>
<td>0-3</td>
<td>0</td>
<td>Minecraft, Call of duty, Halo, Happy Wheels</td>
<td>Chatting, reading, blogging</td>
</tr>
<tr>
<td>ZJ</td>
<td>0-3</td>
<td>0</td>
<td>Minecraft, Call of duty</td>
<td>Chatting, reading, blogging, Doing homework, studying for a test</td>
</tr>
<tr>
<td>SM</td>
<td>6-9</td>
<td>0</td>
<td></td>
<td>Chatting, reading, blogging</td>
</tr>
<tr>
<td>KN</td>
<td>0-3</td>
<td>0</td>
<td>Sims, Soccer</td>
<td>Chatting, reading, blogging</td>
</tr>
<tr>
<td>YL</td>
<td>0-3</td>
<td>0</td>
<td>Minecraft</td>
<td></td>
</tr>
<tr>
<td>NF</td>
<td>3-6</td>
<td>0</td>
<td>Virtual families, Sims3, Action potato, Angry birds</td>
<td>Chatting, reading, blogging</td>
</tr>
<tr>
<td>CH</td>
<td>3-6</td>
<td>0</td>
<td>WOW, Call of duty, Halo</td>
<td>Chatting, reading, blogging</td>
</tr>
<tr>
<td>TE</td>
<td>6-9</td>
<td>0</td>
<td>Minecraft</td>
<td>Doing homework, studying for a test</td>
</tr>
<tr>
<td>HS</td>
<td>0-3</td>
<td>0</td>
<td>Club Penguin, Secret builders</td>
<td>Chatting, reading, blogging</td>
</tr>
<tr>
<td>EC</td>
<td>0-3</td>
<td>0</td>
<td>Wii</td>
<td>Chatting, reading, blogging</td>
</tr>
</tbody>
</table>
## Grade 6.2

<table>
<thead>
<tr>
<th>Initials</th>
<th>Play</th>
<th>Build</th>
<th>No. of hours play</th>
<th>No. of hours build</th>
<th>Games play/played</th>
<th>Software used to build</th>
<th>Perform other tasks</th>
<th>Playing/building as priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>DX</td>
<td>3-6</td>
<td>0-3</td>
<td>3-6</td>
<td>0-3</td>
<td>Madden, Fifa, Asphalt, Need for Speed</td>
<td>Sketch Nation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CH</td>
<td>3-6</td>
<td>0</td>
<td>3-6</td>
<td>0</td>
<td>NHL 13, COD, Black ops, Injustice, Gods among us</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RA</td>
<td>0-3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>Minecraft, Injustice, Lego</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>UM</td>
<td>6-9</td>
<td>0-3</td>
<td>6-9</td>
<td>0-3</td>
<td>MLB 13, Snow Madden, NFL 13</td>
<td>Xcode</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BL</td>
<td>0-3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>Sports and survival games</td>
<td>Chatting, reading, blogging</td>
<td>Doing homework, studying for a test</td>
<td></td>
</tr>
<tr>
<td>FM</td>
<td>0-3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>NHL, Slapshat, Sports games</td>
<td>Chatting, reading, blogging</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AE</td>
<td>3-6</td>
<td>0</td>
<td>3-6</td>
<td>0</td>
<td>Call of duty</td>
<td>Chatting, reading, blogging</td>
<td></td>
<td></td>
</tr>
<tr>
<td>YO</td>
<td>0-3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>Minecraft, Dream League soccer, Subway surfers</td>
<td>Chatting, reading, blogging</td>
<td></td>
<td></td>
</tr>
<tr>
<td>JL</td>
<td>3-6</td>
<td>0</td>
<td>3-6</td>
<td>0</td>
<td>Call of duty</td>
<td>Chatting, reading, blogging</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TO</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MT</td>
<td>6-9</td>
<td>0</td>
<td>6-9</td>
<td>0</td>
<td>Stick War</td>
<td>Chatting, reading, blogging</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HN</td>
<td>6-9</td>
<td>0</td>
<td>6-9</td>
<td>0</td>
<td>Blitz, MW3, Highway Rider, COD 3</td>
<td>Chatting, reading, blogging</td>
<td>Doing homework, studying for a test</td>
<td></td>
</tr>
<tr>
<td>UB</td>
<td>6-9</td>
<td>0</td>
<td>6-9</td>
<td>0</td>
<td>Minecraft, Race 2</td>
<td></td>
<td>Doing homework, studying for a test</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OA</td>
<td>3-6</td>
<td>0</td>
<td>Minecraft</td>
<td>Chatting, reading, blogging</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IE</td>
<td>0-3</td>
<td>0-3</td>
<td>Mario Cart</td>
<td>Sketch Nation, SoThink, SWF Quicker</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ZE</td>
<td>0-3</td>
<td>0</td>
<td>Age of War, Mario, War and racing games</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Female</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DB</td>
<td>0-3</td>
<td>0-3</td>
<td>Minecraft</td>
<td>Scratch</td>
<td>Chatting, reading, blogging</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>KG</td>
<td>6-9</td>
<td>0</td>
<td>Minecraft</td>
<td></td>
<td>Chatting, reading, blogging</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>KE</td>
<td>9-12</td>
<td>0</td>
<td>Minecraft, roblox</td>
<td></td>
<td>Chatting, reading, blogging</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SN</td>
<td>0-3</td>
<td>0</td>
<td>SimCity, XBox</td>
<td></td>
<td>Chatting, reading, blogging</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Doing homework, studying for a test</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PC</td>
<td>0-3</td>
<td>0</td>
<td>Parking games</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PR</td>
<td>0-3</td>
<td>0</td>
<td>Mario Kart</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SR</td>
<td>0-3</td>
<td>0</td>
<td>Super Mario Brothers, Mario Kart</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AP</td>
<td>0-3</td>
<td>0</td>
<td>Minecraft, Xbox</td>
<td></td>
<td>Chatting, reading, blogging</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RK</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Initials</td>
<td>Play</td>
<td>Build</td>
<td>No. of hours play</td>
<td>No. of hours build</td>
<td>Games play/played</td>
<td>Software used to build</td>
<td>Perform other tasks</td>
<td>Playing/building as priority</td>
</tr>
<tr>
<td>----------</td>
<td>------</td>
<td>-------</td>
<td>-------------------</td>
<td>-------------------</td>
<td>-------------------</td>
<td>------------------------</td>
<td>---------------------</td>
<td>-----------------------------</td>
</tr>
<tr>
<td>Male</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SL</td>
<td>SL</td>
<td>SL</td>
<td>0-3</td>
<td>0-3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CR</td>
<td>SL</td>
<td>SL</td>
<td>0-3</td>
<td>0-3</td>
<td>Minecraft, Clash of Clans</td>
<td>Sketch Nation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LL</td>
<td>LL</td>
<td>SL</td>
<td>6-9</td>
<td>3-6</td>
<td>Minecraft, Clash of Clans</td>
<td>Sketch Nation</td>
<td>Chatting, reading, blogging</td>
<td></td>
</tr>
<tr>
<td>UD</td>
<td>LL</td>
<td>LL</td>
<td>9-12</td>
<td>0</td>
<td>Minecraft, WOW, Empires III</td>
<td>Sketch Nation</td>
<td>Chatting, reading, blogging</td>
<td></td>
</tr>
<tr>
<td>OO</td>
<td>LL</td>
<td>LL</td>
<td>0-3</td>
<td>0</td>
<td>Minecraft, Clash of Clans, Bigwin games, pocket arms</td>
<td>Sketch Nation</td>
<td>Chatting, reading, blogging</td>
<td></td>
</tr>
<tr>
<td>SK</td>
<td>LL</td>
<td>LL</td>
<td>3-6</td>
<td>0-3</td>
<td>Minecraft, COD, Sketch Nation</td>
<td>Sketch Nation</td>
<td>Chatting, reading, blogging</td>
<td>Doing homework, studying for a test</td>
</tr>
<tr>
<td>VO</td>
<td>LL</td>
<td>LL</td>
<td>6-9</td>
<td>0</td>
<td>Minecraft, Dragon Vale, Clash of Clans</td>
<td>Sketch Nation</td>
<td>Chatting, reading, blogging</td>
<td>Doing homework, studying for a test</td>
</tr>
<tr>
<td>GB</td>
<td>LL</td>
<td>LL</td>
<td>0-3</td>
<td>0</td>
<td>Minecraft, Nuts and Bolts</td>
<td>Sketch Nation</td>
<td>Chatting, reading, blogging</td>
<td></td>
</tr>
<tr>
<td>UK</td>
<td>SL</td>
<td>SL</td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>JA</td>
<td>SL</td>
<td>SL</td>
<td>0-3</td>
<td>0</td>
<td>Wii, transformers, Nitrome</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MH</td>
<td>LL</td>
<td>LL</td>
<td>0-3</td>
<td>0</td>
<td>Blackops, peer racing, NHL 13, MLB 13</td>
<td>Sketch Nation</td>
<td>Chatting, reading, blogging</td>
<td></td>
</tr>
<tr>
<td>MW</td>
<td>LL</td>
<td>LL</td>
<td>3-6</td>
<td>0</td>
<td>Mario cart, doable dash, donkey kong</td>
<td>Sketch Nation</td>
<td>Chatting, reading, blogging</td>
<td></td>
</tr>
<tr>
<td>NJ</td>
<td>LL</td>
<td>LL</td>
<td>3-6</td>
<td>0-3</td>
<td>Minecraft, Dream League soccer</td>
<td>Sketch Nation</td>
<td>Chatting, reading, blogging</td>
<td></td>
</tr>
<tr>
<td>MX</td>
<td>LL</td>
<td>LL</td>
<td>0-3</td>
<td>0-3</td>
<td>Spore, Portal, Minecraft</td>
<td>Stencyl</td>
<td>Chatting, reading, blogging</td>
<td></td>
</tr>
<tr>
<td>WE</td>
<td>LL</td>
<td>LL</td>
<td>0-3</td>
<td>0-3</td>
<td>Blackops, Minecraft, NHL 13</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>VR</td>
<td>0-3</td>
<td>0</td>
<td>COD, Injustice, Happy wheels, Defense, Minecraft</td>
<td>Chatting, reading, blogging</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>DF</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>YS</td>
<td>12+</td>
<td>0-3</td>
<td>Ski Safari</td>
<td>Sketch Nation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>LR</td>
<td>0-3</td>
<td>0</td>
<td>Mario, Just dance</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>MG</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>SO</td>
<td>0-3</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>NE</td>
<td>3-6</td>
<td>0-3</td>
<td>Minecraft, Dragon Vale, Tree world</td>
<td>Chatting</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>PH</td>
<td>3-6</td>
<td>0</td>
<td>Minecraft, Overlord, WOW, Team, Fortress</td>
<td>Chatting, reading, blogging</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>PT</td>
<td>0-3</td>
<td>0-3</td>
<td>Math games</td>
<td>Sketch Nation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>OR</td>
<td>0-3</td>
<td>0</td>
<td>Club penguin, secret builders</td>
<td>Chatting, reading, blogging</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Doing homework, studying for a test</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Initials</td>
<td>Play</td>
<td>Build</td>
<td>No. of hours play</td>
<td>No. of hours build</td>
<td>Games play/played</td>
<td>Software used to build</td>
<td>Perform other tasks</td>
<td>Playing/building as priority</td>
</tr>
<tr>
<td>----------</td>
<td>------</td>
<td>-------</td>
<td>-------------------</td>
<td>-------------------</td>
<td>-------------------</td>
<td>-----------------------</td>
<td>---------------------</td>
<td>-----------------------------</td>
</tr>
<tr>
<td>Male</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GL</td>
<td></td>
<td></td>
<td>0-3</td>
<td>0</td>
<td>Minecraft, Black ops, Call of Duty, Dragon Vale, NHL 13, Need for speed</td>
<td></td>
<td></td>
<td>Doing homework, studying for a test</td>
</tr>
<tr>
<td>HI</td>
<td></td>
<td></td>
<td>0</td>
<td>0-3</td>
<td>Scratch</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MS</td>
<td></td>
<td></td>
<td>9-12</td>
<td>0</td>
<td>Minecraft, Halo, Call of Duty, Dragon Vale, NHL 13,</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BG</td>
<td></td>
<td></td>
<td>0-3</td>
<td>0</td>
<td>Minecraft</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AU</td>
<td></td>
<td></td>
<td>12+</td>
<td>0-3</td>
<td>Modern Warfare, Black ops, Assasins</td>
<td>Game Maker</td>
<td>Chatting, reading, blogging</td>
<td></td>
</tr>
<tr>
<td>EY</td>
<td></td>
<td></td>
<td>0-3</td>
<td>0</td>
<td>Minecraft, Clash of the Clans</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TM</td>
<td></td>
<td></td>
<td>0-3</td>
<td>0</td>
<td>Golden Eye, Mario Cart, Wii</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CU</td>
<td></td>
<td></td>
<td>0-3</td>
<td>0-3</td>
<td>Minecraft, Need for Speed</td>
<td>Sketch Nation</td>
<td></td>
<td>Doing homework, studying for a test</td>
</tr>
<tr>
<td>Female</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OH</td>
<td></td>
<td></td>
<td>9-12</td>
<td>0</td>
<td>Minecraft, puzzles,</td>
<td></td>
<td>Chatting, reading, blogging</td>
<td></td>
</tr>
<tr>
<td>KS</td>
<td></td>
<td></td>
<td>3-6</td>
<td>0</td>
<td>Wii</td>
<td></td>
<td></td>
<td>Doing homework, studying for a test</td>
</tr>
<tr>
<td>RG</td>
<td></td>
<td></td>
<td>3-6</td>
<td>0</td>
<td>Minecraft, SimCity 3</td>
<td></td>
<td>Chatting, reading, blogging</td>
<td></td>
</tr>
<tr>
<td>CW</td>
<td></td>
<td></td>
<td>0-3</td>
<td>0</td>
<td>Minecraft, halo, Just cause</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ZM</td>
<td></td>
<td></td>
<td>0-3</td>
<td>0</td>
<td>Fable 2, Mario Cart</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Name/Initials</td>
<td>Play</td>
<td>Build</td>
<td>No. of hours play</td>
<td>No. of hours build</td>
<td>Games play/played</td>
<td>Software used to build</td>
<td>Perform other tasks</td>
<td>Playing/building as priority</td>
</tr>
<tr>
<td>----------------</td>
<td>-------</td>
<td>-------</td>
<td>-------------------</td>
<td>-------------------</td>
<td>-------------------</td>
<td>------------------------</td>
<td>----------------------</td>
<td>--------------------------------</td>
</tr>
<tr>
<td>OW</td>
<td>12+</td>
<td>0</td>
<td>Minecraft, Wii, Dragon of Atlantis, Golden Compass,</td>
<td>Chatting, reading, blogging</td>
<td>Doing homework, studying for a test</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VH</td>
<td>0-3</td>
<td>0</td>
<td>Wii</td>
<td>Chatting, reading, blogging</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>KR</td>
<td>9-12</td>
<td>0</td>
<td>Minecraft, puzzles,</td>
<td>Chatting, reading, blogging</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EF</td>
<td>0-3</td>
<td>0</td>
<td>Hay day, Where my Water</td>
<td>Chatting, reading, blogging</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ZY</td>
<td>6-9</td>
<td>0</td>
<td>Minecraft, SimCity, Pokemon</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Grade 6 Teachers/Practitioners**

<table>
<thead>
<tr>
<th>Name/Initials</th>
<th>Play</th>
<th>Build</th>
<th>No. of hours play</th>
<th>No. of hours build</th>
<th>Games play/played</th>
<th>Software used to build</th>
<th>Perform other tasks</th>
<th>Playing/building as priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dave</td>
<td>3-6</td>
<td>0</td>
<td>RPGs, MMORPGs, Card games, puzzles, FPS</td>
<td></td>
<td>Preparing lesson plans</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Matt</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Key:**

- **Players:** Red
- **Builders:** Green
- **Performing other tasks:** Yellow
- **Playing/building as priority:** Blue
- **No action:** grey
Appendix E

My Learner Profile Survey

Instructions: In the My Learner Profile Survey, you will select the statements that best describe your learner characteristics.

How well do these statements describe you?

1. I create and write stories very well.
   ○ That describes me quite well.
   ○ That doesn’t describe me.

2. I write songs or create music/sounds very well.
   ○ That describes me quite well.
   ○ That doesn’t describe me.

3. I programme or code games very well.
   ○ That describes me quite well.
   ○ That doesn’t describe me.

4. I draw and do artwork very well.
   ○ That describes me quite well.
   ○ That doesn’t describe me.

5. I spend a lot of time blogging or chatting online.
   ○ That describes me quite well.
   ○ That doesn’t describe me.

6. I enjoy designing and building things.
   ○ That describes me quite well.
   ○ That doesn’t describe me.

7. When I am presented with a toy to assemble, I would most likely discard the printed directions and figure out how to build it myself?
   ○ That describes me quite well.
   ○ That doesn’t describe me.
8. I like to solve problems, especially in real life situations.
   - That describes me quite well.
   - That doesn't describe me.

9. When in a group, I always find myself taking the role of leader.
   - That describes me quite well.
   - That doesn't describe me.

Thank you for taking this survey!

Name: ...........................................................................

Gender: ..............................................
Results of the My Learner Profile Survey

Response to Survey on Learner Profile

Grade 6.1

<table>
<thead>
<tr>
<th>Initials</th>
<th>Create and write stories</th>
<th>Write songs and create music</th>
<th>Programme or code games</th>
<th>Draw and do artwork</th>
<th>Spend a lot of time blogging and chatting online</th>
<th>Enjoy designing and building things</th>
<th>Discard printed directions and figure out how to build myself</th>
<th>Like to solve problems in real life situations</th>
<th>Taking role of leader in group</th>
</tr>
</thead>
<tbody>
<tr>
<td>D</td>
<td>ND</td>
<td>D</td>
<td>ND</td>
<td>D</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
</tr>
<tr>
<td>TN</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AB</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>KE</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MB</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VN</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WM</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OD</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NY</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GT</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WP</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AM</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GC</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LT</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EB</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LG</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HM</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ZI</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SM</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>KN</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>YL</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NF</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CH</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TE</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EC</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Male

Female
## Grade 6.2

<table>
<thead>
<tr>
<th>Initials</th>
<th>Create and write stories</th>
<th>Write songs and create music</th>
<th>Program me or code games</th>
<th>Draw and do artwork</th>
<th>Spend a lot time blogging and chatting online</th>
<th>Enjoy designin g and building things</th>
<th>Discard printed directions and figure out how to build myself</th>
<th>Like to solve problems in real life situations</th>
<th>Taking role of leader in group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>D</td>
<td>ND</td>
<td>D</td>
<td>ND</td>
<td>D</td>
<td>ND</td>
<td>D</td>
<td>ND</td>
<td>D</td>
</tr>
<tr>
<td>Male</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DX</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CH</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>UM</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BL</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FM</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AE</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>YO</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>JL</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TO</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MT</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HN</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>UB</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IE</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ZE</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DB</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>KG</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>KE</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SN</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PC</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PR</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SR</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AP</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RK</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Grade 6.3

<table>
<thead>
<tr>
<th>Initials</th>
<th>Create and write stories</th>
<th>Write songs and create music</th>
<th>Program or code games</th>
<th>Draw and do artwork</th>
<th>Spend a lot time blogging and chatting online</th>
<th>Enjoy designing and building things</th>
<th>Discard printed directions and figure out how to build myself</th>
<th>Like to solve problems in real life situations</th>
<th>Taking role of leader in group</th>
</tr>
</thead>
</table>
Grade 6.4

<table>
<thead>
<tr>
<th>Initials</th>
<th>Create and write stories</th>
<th>Write songs and create music</th>
<th>Programme or code games</th>
<th>Draw and do artwork</th>
<th>Spend a lot time blogging and chatting online</th>
<th>Enjoy designing and building things</th>
<th>Discard printed directions and figure out how to build myself</th>
<th>Like to solve problems in real life situations</th>
<th>Taking role of leader in group</th>
</tr>
</thead>
<tbody>
<tr>
<td>D  N  D</td>
<td>D  D  N  D</td>
<td>D  N  D</td>
<td>D  N  D</td>
<td>D  N  D</td>
<td>D  N  D</td>
<td>D  ND</td>
<td>D  ND</td>
<td>D  ND</td>
<td>D  ND</td>
</tr>
</tbody>
</table>

Male

<table>
<thead>
<tr>
<th>ND</th>
<th>UR</th>
<th>CV</th>
<th>HY</th>
<th>UW</th>
<th>JW</th>
<th>CN</th>
<th>GL</th>
<th>HI</th>
<th>MS</th>
<th>BG</th>
<th>AU</th>
<th>TM</th>
<th>EY</th>
<th>CU</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Female

<table>
<thead>
<tr>
<th>OH</th>
<th>KS</th>
<th>RG</th>
<th>CW</th>
<th>ZM</th>
<th>OW</th>
<th>VH</th>
<th>KR</th>
<th>EF</th>
<th>ZY</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Key:  
Create and write stories: Yellow  
Write songs and create music: Purple  
Programme or code games: Blue  
Draw and do artwork: Magenta  
Blogging, building and problem-solving skills: Red  
Taking role of leader in group: Green

D: Describes  
ND: Not Describe
Appendix F

Observation Protocols

CLASSROOM TEACHER OBSERVATION PROTOCOL for Teacher Performance and Behaviours

Text in red represents modifications to this protocol during observation period.

<table>
<thead>
<tr>
<th>Teacher performance and behaviours</th>
<th>Rating scale</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Seeking various modes of problem solving</strong></td>
<td>3 2 1</td>
</tr>
<tr>
<td>• encouraging discussion of alternative explanations</td>
<td></td>
</tr>
<tr>
<td>• presenting inquiry opportunities for students</td>
<td></td>
</tr>
<tr>
<td>• providing alternative learning strategies</td>
<td></td>
</tr>
<tr>
<td><strong>Reflective learning</strong></td>
<td>3 2 1</td>
</tr>
<tr>
<td>• encouraging students to explain their understanding of given instructions</td>
<td></td>
</tr>
<tr>
<td>• encouraging students to explain their understanding of concepts in given</td>
<td></td>
</tr>
<tr>
<td>content</td>
<td></td>
</tr>
<tr>
<td>• encouraging students to apply their understanding of concepts in given</td>
<td></td>
</tr>
<tr>
<td>content to draft stories for their games</td>
<td></td>
</tr>
<tr>
<td>• encouraging students to explain <em>what</em> and <em>how</em> they are learning in their</td>
<td></td>
</tr>
<tr>
<td>own words</td>
<td></td>
</tr>
<tr>
<td>• routinely asking for student input and questions including anything</td>
<td></td>
</tr>
<tr>
<td>unclear to them</td>
<td></td>
</tr>
<tr>
<td>• encouraging students to evaluate their own progress toward understanding and applying the specified content in real world contexts</td>
<td></td>
</tr>
<tr>
<td><strong>Conceptual thinking</strong></td>
<td>3 2 1</td>
</tr>
<tr>
<td>• encouraging students to extend concepts and skills informed by research</td>
<td></td>
</tr>
<tr>
<td>• assisting students in relating integral ideas to broader concepts</td>
<td></td>
</tr>
<tr>
<td><strong>Divergent thinking</strong></td>
<td>3 2 1</td>
</tr>
<tr>
<td>• accepting multiple responses to problem-solving situation/questions</td>
<td></td>
</tr>
<tr>
<td>• providing example evidence for student interpretation</td>
<td></td>
</tr>
<tr>
<td>• encouraging students to challenge the content as well as each other</td>
<td></td>
</tr>
<tr>
<td>• encouraging alternate interpretations of content and solutions to problems/via questions</td>
<td></td>
</tr>
<tr>
<td>• encouraging students to critique alternate solution strategies of teacher and peers</td>
<td></td>
</tr>
<tr>
<td><strong>Pedagogical content knowledge</strong></td>
<td>3 2 1</td>
</tr>
<tr>
<td>• presenting accurate information appropriate to student cognitive level</td>
<td></td>
</tr>
<tr>
<td>• selecting and using strategies that make content understandable to students</td>
<td></td>
</tr>
<tr>
<td>• recognizing students’ ideas even when vaguely articulated</td>
<td></td>
</tr>
<tr>
<td>Intellectual rigor, constructive criticism, and the challenging of ideas</td>
<td>3</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>• encouraging input and challenging students’ ideas</td>
<td></td>
</tr>
<tr>
<td>• non-judgmental of student opinions</td>
<td></td>
</tr>
<tr>
<td>• soliciting alternative explanations for decisions</td>
<td></td>
</tr>
<tr>
<td>• encouraging evidence-based arguments</td>
<td></td>
</tr>
<tr>
<td>• encouraging students to listen critically to others’ explanations</td>
<td></td>
</tr>
<tr>
<td>• encouraging students to challenge each other’s explanations</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Instructional strategies and activities to probe students’ existing knowledge and preconceptions</th>
<th>3</th>
<th>2</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>• pre-assessed students for their thinking</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• helping students confront and/or build on their ideas/questions</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• refocusing activities based on student ideas to meet their needs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• encouraging students to express their ideas even when incorrect or different from the ideas of their peers</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• encouraging students to respond to the ideas of their teachers and peers</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Connections between content and real life/world situations</th>
<th>3</th>
<th>2</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>• encouraging students to apply content/questions to real-world situations for problem solution</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• encouraging students to apply content/questions to personal lives for problem solution</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Coaching and scaffolding (Masters and Yelland, 2002)</th>
<th>3</th>
<th>2</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>• providing for coaching at critical times</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• enforcing tasks</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• prompting students for ideas/deeper questions</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• reviewing each stage/process with students</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• prospecting the next movement with the students</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• narrowing the choices of ideas if students cannot decide on one in the process of brainstorming</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• defining the roles among each student</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• guiding students’ time management</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Teacher-student discourse and collaboration</th>
<th>3</th>
<th>2</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>• organizing students for group work</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• assisting students in forming game design teams</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• interacting with small groups of students</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• providing clear outcomes for groups</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• working collaboratively or cooperatively with students (individually and in groups) to accomplish work relevant to specified tasks</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• exchanging ideas related to each phase of the process</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Teacher-teacher discourse and collaboration (Is it at a deeper level than in previous classes?)</th>
<th>3</th>
<th>2</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>• organizing students’ daily tasks</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• modifying initial design for intervention</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• working collaboratively or cooperatively with each other to accomplish work relevant to specified tasks</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

400
Mainly Adapted from OCEPT-Teacher Observation Protocol (O-TOP) (Flick, Morrell, Wainwright, 2002)

**Formative assessment** (OECD, 2005)  
- teachers making frequent, interactive assessments of student understanding  
- teachers establishing and communicating learning goals to students  
- teachers adjusting goals to better meet student needs  
- teachers adjusting their teaching to meet individual student needs  
- teachers building students’ skills at peer-assessment  
- teachers building students’ skills at self-assessment  
- teachers making efforts to understand cultural preconceptions  
- teachers interacting frequently with individual or small groups of students  
- teachers involving students in the assessment process, providing them with tools to judge the quality of their own work  
- teachers tracking student progress  
- teachers comparing their assessments with other teachers to ensure that they are treating students equitably  
- teachers adjusting their strategies to meet needs identified in assessment.  
- students developing self-confidence in the classroom

<table>
<thead>
<tr>
<th>Key:</th>
<th>evident</th>
<th>somewhat evident</th>
<th>not evident</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

**Feedback**  
- Feedback is specific and tied to explicit criteria  
- Feedback is timely  
- Feedback is continuous

<table>
<thead>
<tr>
<th>Key:</th>
<th>evident</th>
<th>somewhat evident</th>
<th>not evident</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>
CLASSROOM OBSERVATION PROTOCOL for Student Deep Learning of Content

In what ways does the design and building of digital video games provide the student participants with opportunities to develop deep learning of the curriculum content presented and other emerging content and skills?

<table>
<thead>
<tr>
<th>Student deep learning of content</th>
<th>Rating Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge creation (Biggs, 1987, 2003; Entwistle, 1981; Entwistle, 2000; Fullan &amp; Langworthy, 2014; Ramsden, 2003; Schwartz, 1999; Tagg, 2003)</td>
<td>3 2 1</td>
</tr>
<tr>
<td>▪ possessing sound background knowledge and skills</td>
<td></td>
</tr>
<tr>
<td>▪ making connections with previous knowledge and examining evidence to understand the content</td>
<td></td>
</tr>
<tr>
<td>▪ reflecting on one’s own knowledge and ideas</td>
<td></td>
</tr>
<tr>
<td>▪ reflecting on other’s knowledge and ideas</td>
<td></td>
</tr>
<tr>
<td>▪ sharing ideas and considering alternative viewpoints</td>
<td></td>
</tr>
<tr>
<td>▪ exploring new concepts and new knowledge without fear of failure</td>
<td></td>
</tr>
<tr>
<td>▪ retrieving and transferring knowledge to other situations or real world contexts</td>
<td></td>
</tr>
<tr>
<td>▪ individually constructing knowledge</td>
<td></td>
</tr>
<tr>
<td>▪ constructing knowledge supported through collaborations</td>
<td></td>
</tr>
<tr>
<td>▪ socially constructing knowledge</td>
<td></td>
</tr>
<tr>
<td>▪ constructing knowledge using real world content</td>
<td></td>
</tr>
<tr>
<td>▪ constructing knowledge using varied information sources</td>
<td></td>
</tr>
<tr>
<td>▪ constructing knowledge through negotiation of meaning</td>
<td></td>
</tr>
<tr>
<td>▪ Students integrating new knowledge and understanding with their own prior cognitive structures</td>
<td></td>
</tr>
<tr>
<td>▪ students contributing new ideas and/or new points of view</td>
<td></td>
</tr>
<tr>
<td>▪ students building upon or relating to previous individual contribution(s)</td>
<td></td>
</tr>
<tr>
<td>▪ students building upon or relating to previous peer contribution(s)</td>
<td></td>
</tr>
<tr>
<td>▪ students building upon or relating to previous teacher contribution(s)</td>
<td></td>
</tr>
<tr>
<td>Disciplined inquiry (Newmann, King &amp; Carmichael, 2007)</td>
<td>3 2 1</td>
</tr>
<tr>
<td>▪ demonstrating complex understanding of knowledge to gain deeper understanding of specific problems</td>
<td></td>
</tr>
<tr>
<td>▪ demonstrating their understanding of the problematic nature of information or ideas</td>
<td></td>
</tr>
<tr>
<td>▪ expressing reasoned conclusions</td>
<td></td>
</tr>
<tr>
<td>▪ providing information, arguments or reasoning that demonstrate the complexity of an important idea</td>
<td></td>
</tr>
<tr>
<td>Critical thinking skills (Fullan &amp; Langworthy, 2014; Lenz, 2014)</td>
<td>3 2 1</td>
</tr>
<tr>
<td>▪ reflecting on their thinking and exploring new ideas</td>
<td></td>
</tr>
<tr>
<td>▪ reflecting on different points of view through brainstorming</td>
<td></td>
</tr>
<tr>
<td>▪ recognizing strengths in their reasoning and ideas</td>
<td></td>
</tr>
<tr>
<td>▪ recognizing weaknesses in their reasoning and ideas</td>
<td></td>
</tr>
<tr>
<td>▪ recognizing strengths in the positions presented by others</td>
<td></td>
</tr>
<tr>
<td>▪ recognizing weaknesses in the positions presented by others</td>
<td></td>
</tr>
<tr>
<td>▪ identifying, evaluating, and developing new ideas</td>
<td></td>
</tr>
<tr>
<td>▪ examining logical relationships among statements</td>
<td></td>
</tr>
</tbody>
</table>
- examining and assessing new ideas by identifying and analyzing arguments
- synthesizing and making connections between information and arguments
- interpreting information and drawing conclusions based on the best analysis
- categorizing, decoding and clarifying information
- analyzing and evaluating other points of view

Higher order thinking skills (Newmann, King & Carmichael, 2007)

- manipulating information and ideas in ways that transform their meanings and implications
- combining facts and ideas in order to synthesize and explain or arrive at some conclusion or interpretation
- organizing, interpreting, evaluating prior knowledge to solve new problems
- analyzing facts to create conceptual models and frameworks
- synthesizing facts to create conceptual models and frameworks

Teacher-student interaction and understanding (Claxton, 2007; Dunleavy & Milton, 2009; Friesen, 2008; Fullan & Langworthy, 2014)

- sustaining teacher-student interaction reciprocally
- sustaining teacher-student interaction to promote coherent shared understanding about the content
- students actively construct their learning in partnership with teachers
- students actively work toward deep conceptual understanding in partnership with teachers
- students actively build new knowledge in partnership with teachers
- students actively explore and discuss content in partnership with teachers
- striving for in-depth understanding rather than superficial awareness

Student-student collaborative discourse (Bohm, 1990; Fullan & Langworthy, 2014; Harasim, 1990; McKay & Kember, 1997; Millis, 2002; Millis, 2010; Rhem, 1995)

- presenting and articulating personal experience, thoughts, and opinions
- identifying and discussing alternatives
- brainstorming
- reflecting upon the different aspects of the subject matter
- reflecting upon own thinking
- reflecting upon different views of others
- repairing or strengthening his/her positions and arguments
- deepening his/her understanding
- comparing and identifying differences and commonalities
- group reaching shared understanding and convergence
### Communication (Fullan & Langworthy, 2014; Slattery, 2006)

<table>
<thead>
<tr>
<th>3</th>
<th>2</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>- students using elaborated or complex forms of communication, such as verbal, symbolic, graphic, visual to conduct their work and to present its results</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- students using a variety of verbal and nonverbal modes to communicate with peers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- students using a variety of verbal and nonverbal modes to communicate with teachers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- students demonstrating the ability to listen with purpose</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- students demonstrating the ability to interact respectfully with others</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- students recognizing some connection between the content and situations outside the classroom</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Active learning (Entwistle, 2000; McKay & Kember, 1997; Simms, 2006; West-Burnham & Coates, 2005)

<table>
<thead>
<tr>
<th>3</th>
<th>2</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>- searching for patterns and principles while using evidence and logic</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- working collaboratively to make connections with other work and being able to evaluate their own progress</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- designing learning through processes of co-construction</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- designing assessment through processes of co-construction</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- engaging and interacting with one another</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- checking evidence and relating it to conclusions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- examining logic and argument of their ideas cautiously and critically</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- becoming actively interested in course content</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- intrinsically motivated</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- showing a sense of ownership of the material</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- approaching the same material in multiple ways</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Formative assessment (Black & Wiliam, 1998a; Earl, 2003; Fullan & Langworth, 2014; Lenz, 2014; OECD, 2005; Taras, 2010; West-Burnham & Coates, 2005)

<table>
<thead>
<tr>
<th>3</th>
<th>2</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>- teachers making frequent, interactive assessments of student understanding</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- teachers establishing and communicating learning goals to students</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- teachers adjusting goals to better meet student needs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- teachers adjusting their teaching to meet individual student needs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- teachers building students’ skills at peer-assessment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- teachers building students’ skills at self-assessment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- teachers interacting frequently with individual or small groups of students</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- teachers involving students in the assessment process, providing them with tools to judge the quality of their own work</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- teachers tracking student progress</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- teachers comparing their assessments with other teachers to ensure that they are treating students equitably</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- teachers adjusting their strategies to meet needs identified in assessment.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- students developing self-confidence in the classroom</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Self assessment/peer assessment (Earl, 2003; Lenz, 2014)

- students assessing the quality of their own work
- students assessing the quality of peers’ work

### Feedback (Fullan & Langworthy, 2014; Hattie, 2009; Hattie & Timperley, 2007)

<table>
<thead>
<tr>
<th>Feedback Features</th>
<th>Evident</th>
<th>Somewhat evident</th>
<th>Not evident</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feedback is specific and tied to explicit criteria</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Feedback is timely</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Feedback is continuous</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Key:**

- Evident: 3
- Somewhat evident: 2
- Not evident: 1
In what ways does the design and building of digital video games provide the student participants with opportunities for intellectual engagement?

The list of elements for intellectual engagement (flow, motivation, effort, enjoyment, interest, relevance) were adapted from Wilms, Friesen and Milton (2009). The description of each element was obtained from other research sources.

<table>
<thead>
<tr>
<th>Intellectual Engagement of Students</th>
<th>Rating Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>'Flow' state (Czikszentmihalyi, 1990)</td>
<td>3 2 1</td>
</tr>
<tr>
<td>▪ completely involved, focused, concentrating on task (effort)</td>
<td></td>
</tr>
<tr>
<td>▪ sense of ecstasy—of being outside everyday reality</td>
<td></td>
</tr>
<tr>
<td>▪ great inner clarity—knowing what needs to be done and how well it is going</td>
<td></td>
</tr>
<tr>
<td>▪ knowing the activity is doable—skills are adequate and neither anxious or bored</td>
<td></td>
</tr>
<tr>
<td>▪ sense of serenity</td>
<td></td>
</tr>
<tr>
<td>▪ timeliness—thoroughly focused on present, don’t notice time passing (effort)</td>
<td></td>
</tr>
<tr>
<td>▪ Intrinsic motivation (intense emotional and intellectual excitement)</td>
<td></td>
</tr>
<tr>
<td>Motivation (Willms, Friesen, &amp; Milton, 2009)</td>
<td>3 2 1</td>
</tr>
<tr>
<td>▪ students work to achieve their goals</td>
<td></td>
</tr>
<tr>
<td>▪ students try to do their tasks very well</td>
<td></td>
</tr>
<tr>
<td>▪ students try to complete their tasks on time</td>
<td></td>
</tr>
<tr>
<td>▪ students try to work well within their groups (social motivation) Maslow</td>
<td></td>
</tr>
<tr>
<td>▪ students are confident in their contributions to their groups</td>
<td></td>
</tr>
<tr>
<td>▪ Students use their skills and abilities to learn the content at a deep level</td>
<td></td>
</tr>
<tr>
<td>▪ Students use their skills and abilities to help their groups learn the content at a deep level</td>
<td></td>
</tr>
<tr>
<td>▪ Students use their skills and abilities to help their groups design and build their games</td>
<td></td>
</tr>
<tr>
<td>Effort (Willms, Friesen, &amp; Milton, 2009)</td>
<td>3 2 1</td>
</tr>
<tr>
<td>▪ students devote many hours to their tasks individually</td>
<td></td>
</tr>
<tr>
<td>▪ students devote many hours to their tasks in their groups</td>
<td></td>
</tr>
<tr>
<td>▪ Students are immersed in their tasks</td>
<td></td>
</tr>
<tr>
<td>▪ Students are willing to struggle with challenging or complex ideas</td>
<td></td>
</tr>
<tr>
<td>▪ Students are willing to struggle with challenging or complex tasks</td>
<td></td>
</tr>
<tr>
<td>Enjoyment (Friesen, 2009; Wilhelm, Hülür, Gasimova &amp; Robitzsch, 2014; Willms, Friesen, &amp; Milton, 2009)</td>
<td>3 2 1</td>
</tr>
<tr>
<td>▪ students have fun while working on their tasks</td>
<td></td>
</tr>
<tr>
<td>▪ students are bored with their tasks</td>
<td></td>
</tr>
<tr>
<td>▪ students are enthusiastic about working on their tasks</td>
<td></td>
</tr>
<tr>
<td>▪ students spend most of their time doing off-task activities</td>
<td></td>
</tr>
<tr>
<td><strong>Interest</strong> (Ainley, Hidi &amp; Berndorff, 2002; Willms, Friesen, &amp; Milton, 2009)</td>
<td>3</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>▪ students initiate interest in the topic and content to be studied</td>
<td></td>
</tr>
<tr>
<td>▪ students initiate interest in the problem(s) to be solved</td>
<td></td>
</tr>
<tr>
<td>▪ students demonstrate a desire to learn about their topic in a new context</td>
<td></td>
</tr>
<tr>
<td>▪ students demonstrate sustained interest to learn about their topic in a new context</td>
<td></td>
</tr>
<tr>
<td>▪ students seek opportunities for continual engagement in their tasks</td>
<td></td>
</tr>
<tr>
<td>▪ Students demonstrate resistance when asked to stop tasks</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Relevance</strong> (Claxton, 2007; Dunleavy &amp; Milton 2009; Willms, Friesen, &amp; Milton, 2009; Windham, 2005)</th>
<th>3</th>
<th>2</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>▪ students’ learning activities apply to real-life scenarios</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>▪ Students work with authentic problems (Claxton, 2007;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>▪ topics and activities/tasks connect with students’ interests and concerns</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Key:</strong></th>
<th><strong>Evident</strong></th>
<th><strong>Somewhat evident</strong></th>
<th><strong>Not evident</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>2</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>
CLASSROOM OBSERVATION PROTOCOL for Development and Use of Twenty-First Century Competencies

In what ways does the design and building of digital video games provide the student participants with opportunities to develop and use 21st century competencies?

<table>
<thead>
<tr>
<th>21st Century Competencies for Students</th>
<th>Rating Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Critical Thinking</td>
<td>3 2 1</td>
</tr>
<tr>
<td>• reflecting on their thinking</td>
<td></td>
</tr>
<tr>
<td>• reflecting on different points of view</td>
<td></td>
</tr>
<tr>
<td>• recognizing strengths in their reasoning</td>
<td></td>
</tr>
<tr>
<td>• recognizing weaknesses in their reasoning</td>
<td></td>
</tr>
<tr>
<td>• recognizing strengths in the positions presented by others</td>
<td></td>
</tr>
<tr>
<td>• recognizing weaknesses in the positions presented by others</td>
<td></td>
</tr>
<tr>
<td>• identifying, evaluating, and constructing arguments</td>
<td></td>
</tr>
<tr>
<td>• examining logical relationships among statements</td>
<td></td>
</tr>
<tr>
<td>• examining ideas by identifying and analysing arguments</td>
<td></td>
</tr>
<tr>
<td>• synthesizing and making connections between information and arguments</td>
<td></td>
</tr>
<tr>
<td>• interpreting information and drawing conclusions based on the best analysis</td>
<td></td>
</tr>
<tr>
<td>• categorizing, decoding and clarifying information</td>
<td></td>
</tr>
<tr>
<td>• analyzing and evaluating other points of view</td>
<td></td>
</tr>
<tr>
<td>• concentrating for extended periods of time</td>
<td></td>
</tr>
<tr>
<td>• concentrating for short periods of time</td>
<td></td>
</tr>
<tr>
<td>Problem Solving and Decision Making</td>
<td>3 2 1</td>
</tr>
<tr>
<td>• solving simple novel problems related to their learning</td>
<td></td>
</tr>
<tr>
<td>• solving complex novel problems related to their learning</td>
<td></td>
</tr>
<tr>
<td>• solving simple ill-defined problems related to their learning</td>
<td></td>
</tr>
<tr>
<td>• solving complex ill-defined problems related to their learning</td>
<td></td>
</tr>
<tr>
<td>• using multiple approaches to solving a problem</td>
<td></td>
</tr>
<tr>
<td>• using a variety of resources in arriving at a solution to a problem</td>
<td></td>
</tr>
<tr>
<td>• using the knowledge and experience gained to inform their ability to solve problems</td>
<td></td>
</tr>
<tr>
<td>• making reasoned judgments</td>
<td></td>
</tr>
<tr>
<td>• making decisions</td>
<td></td>
</tr>
<tr>
<td>Creativity and Innovation</td>
<td>3 2 1</td>
</tr>
<tr>
<td>• demonstrating initiative, imagination, spontaneity and ingenuity in a range of creative processes</td>
<td></td>
</tr>
<tr>
<td>• creating new and worthwhile ideas</td>
<td></td>
</tr>
<tr>
<td>• elaborating, refining, analyzing and evaluating their own ideas in order to improve and maximize creative efforts context</td>
<td></td>
</tr>
<tr>
<td>• working creatively with others</td>
<td></td>
</tr>
<tr>
<td>• developing, implementing and communicating new ideas to others effectively</td>
<td></td>
</tr>
<tr>
<td>• recognizing and accepting mistakes as part of the creative process and as an opportunity to learn</td>
<td></td>
</tr>
<tr>
<td>• demonstrating flexibility and adaptability in response to change</td>
<td></td>
</tr>
</tbody>
</table>
- embracing ambiguity and uncertainty
- willing to take risks
- demonstrating initiative, resiliency and perseverance when faced with obstacles and challenges

**Communication**

<table>
<thead>
<tr>
<th></th>
<th>3</th>
<th>2</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>using a variety of verbal and nonverbal modes to communicate with peers</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>using a variety of verbal and nonverbal modes to communicate with teachers</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>demonstrating the ability to listen with purpose</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>demonstrating the ability to interact respectfully with others</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>demonstrating ability to make others understand</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>demonstrating ability to formulate arguments</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Information Literacy**

<table>
<thead>
<tr>
<th></th>
<th>3</th>
<th>2</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>accessing and evaluating information from a variety of sources to learn individually or with others</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>accessing and evaluating information from a variety of sources to communicate</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>accessing and evaluating information from a variety of sources to come to new understandings</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>accessing and evaluating information from a variety of sources to inform problem solving</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>accessing and evaluating information from a variety of sources to support decision making</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>demonstrating ability to use information to support critical thinking</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>demonstrating ability to use information to support creativity and innovation in different contexts</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>accessing, understanding and manipulating digital information creatively and effectively for sharing and creation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>using technology critically and safely</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Collaboration and Teamwork**

<table>
<thead>
<tr>
<th></th>
<th>3</th>
<th>2</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>building respectful, caring and effective relationships to manage conflict and differences</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>building respectful, caring, honest and effective relationships to seek consensus in the pursuit of common goals</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>accepting responsibility for their actions as individuals</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>leveraging social and cultural differences to create new ideas</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>sharing responsibility as team members</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>working effectively in diverse teams</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>working with others to influence, motivate and mentor all members</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>leveraging the strengths of others to accomplish a common goal</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>showing flexibility in being able to work with a diversity of people in varying situations</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>managing projects by prioritizing, planning and managing work to achieve the intended group result</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>guiding and leading others by using interpersonal and problem-solving skills to influence and guide others toward a goal</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>using their influence and powers responsibly</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
- keeping the interests of the larger community and group in mind

**Living in the world - citizenship, local and global**

- participating in learning community activities
- displaying solidarity by showing an interest in and helping to solve problems affecting the local learning community
- displaying solidarity by showing an interest in and helping to solve problems affecting the wider learning community
- interfacing effectively with institutions in the public domain

**Living in the world - life and career**

- Operating in varied roles, responsibilities
- Being flexible by incorporating feedback effectively
- Being flexible by negotiating and balancing diverse views and beliefs to reach workable solutions
- Utilizing time and manage workload efficiently
- Leveraging social and cultural differences to create new ideas and increase both innovation and quality of work
- Setting and meeting goals, prioritizing, planning and managing work to achieve the intended result even in the face of obstacles and competing pressures
- Using interpersonal and problem solving skills to influence and guide others toward a goal
- Leveraging strengths of others to accomplish a common goal
- Inspiring others to reach their very best via example and selflessness
- Demonstrating integrity and ethical behavior in using influence and power

Adapted from Binkley, Erstad, Herman, Raizen, Ripley and Rumble’s (2010) Draft White Paper 1: Defining 21st century skills

<table>
<thead>
<tr>
<th>Key:</th>
<th>Evident 3</th>
<th>Somewhat evident 2</th>
<th>Not evident 1</th>
</tr>
</thead>
</table>
Appendix G

Grade Six Teachers’ and Students’ Pre-interviews

Pre-interview FOR TEACHERS

School: Charter School Date: October 2, 3, 2013

1. What instructional strategies do you presently use to teach Social Studies?

2. Do you use any technologies with these strategies? If not, why?

3. If so, which technologies do you use?

4. Are these strategies highly successful in engaging your students in learning the content in Social Studies?

5. How do you measure student’s engagement as they learn the curriculum content in Social Studies?

6. Do these strategies also promote deep learning of the curriculum content in Social Studies?

7. If yes, how do you measure for deep learning of the curriculum content?

8. Do these strategies promote students’ development of 21st century competencies as they learn the curriculum content?

9. If so, which specific competencies have you observed or measured?

10. What are the learning characteristics of your students?

11. Do you think your strategies are successfully meeting their learning needs?

12. Do you believe that there a disconnection or gap between how a digitally immersed school population is taught in the formal classroom space and how it learns?

13. What are your opinions on using the design of and building of digital video games as a new way to teach the Social Studies curriculum?
Pre-interview FOR STUDENTS

School: __Charter School___ Date: ___October 2; 3, 2013___

1. Do you enjoy school? If yes, why? If no, why?

2. How does your teacher teach you Social Studies?

3. Do you enjoy and learn from these lessons in Social Studies? If yes, why? If no, why?

4. Do your teacher use technologies to teach in some of your lessons?

5. If yes, what types of technologies does he use?

6. If no, why do you think he does not use them?

7. How would you prefer to learn in your Social Studies class?

8. How many years of experience do you have using the computer or iPad?

9. Do you play video games?

10. What games do you play?

11. On average, how much time do you devote to playing these games?

12. Do you build video games?

13. If so, what games have you built?

14. What game software did you use to build your video games?

15. How would you feel about designing and building digital video games to learn certain concepts in your Social Studies class?
Appendix H

Grade Six Teachers’ and Students’ Mid-interviews

Mid-interview FOR TEACHERS

School: Charter School

Date: April 29 and May 2, 2014

Goal of mid-interview

To find out what teachers needed to begin doing (differently) in their design of instruction and
learning tasks’ activities while they accommodated a game design and building context or
strategy in the classroom.

Session 1

Introduction

1. Is using a game design and building context proving to be more work for you in terms
   of designing your instruction and tasks’ activities to assist your students in learning
   about how the citizens in their various models participated in the government decision-
   making process? If so, how and why?

2. So far, in what ways have you observed that your design of instruction and tasks’
   activities needed to change or be modified to accommodate this game design and
   building strategy to help students learn about how the citizens in their various models
   participated in the government decision-making process?

Thinking process

1. During the process, so far, (game concept development and storyboarding stages) I
   observed that you encouraged a great deal of reflective thinking (by that I mean [list
   items from protocol]). Did you need to promote this type of thinking to a much greater
   degree in using the video game design process? If so, why? If not, why?
2. During the game concept development and storyboarding tasks, did you have to encourage conceptual thinking (by that I mean [list items from protocol]) to a greater degree than you would normally do in your instruction? If so, why? If not, why?

3. In which of these tasks was this type of thinking most required/necessary? Why?

4. During the game concept development and storyboarding tasks, there is also much evidence of your encouragement to use divergent thinking skills (by that I mean [list items from protocol]). Like conceptual thinking, did you have to encourage this type of thinking to a greater degree than you would normally do? If so, why? If not, why?

5. In which of these tasks was this type of thinking most required/necessary? Why?

Collaboration

6. So far, I observed that student-student discourse and collaboration (group work) were highly evident to ensure students’ learning and progress during the process. Did students need to engage in this type of collaboration or participatory-type of learning more extensively and at a much deeper level than you would normally do in your classes? If so, why? If not, why?

7. In designing the tasks’ activities for the students in each session, was there a need for students to have more control of their learning by allowing greater peer interaction and access to [other students’] ideas, experiences, and knowledge? If so, Why?

8. So far, I also observed that teacher-student discourse and collaboration were highly evident to ensure students’ learning and progress during the process. Did you need to engage in this teacher-student discourse and collaboration more extensively and at a much deeper level than you would normally do in your classes? If so, why?
9. I also observed that a significant amount of teacher-teacher discourse and collaboration to plan, assess and provide continuous feedback to all the students/groups during the process, so far. Did you need to engage in this type of teacher-teacher discourse and collaboration more extensively and at a much deeper level than you would normally do in your classes? If so, Why?

10. Up to this point in the process, has this collaboration helped students learn and understand how the citizens in their various models participated in the government decision-making process at a deeper level? If so, in what ways? If not, why?

11. Up to this point in the process, has this collaboration encouraged students’ intellectual engagement in their learning? If so, in what ways? If not, why?

12. Up to this point in the process, has this collaboration encouraged students’ development of 21st century competencies? If so, in what ways? If not, why?

13. Up to this point in the process, in terms of your pedagogical content knowledge (by that I mean [list items from protocol]), what strategies/techniques did you have to use to make the curriculum content more meaningful/understandable to your students?

**Coaching and scaffolding**

14. In terms of coaching and scaffolding (by that I mean [list items from protocol]) what was different for you in your instruction (if any) up to this point? Why?

15. During this coaching and scaffolding, what kind of guidance did you need to provide to the students/groups to ensure that: (a) deep learning; (b) Intellectual engagement; (c) development of 21st century competencies were taking place?

16. Did you need to coach and scaffold students more frequently in this project? Why?

17. Was coaching and scaffolding very critical to this process? Why?

18. Did you have to enforce the tasks more frequently? Why?
19. Did you have to review each step of the process with your students more frequently? Why? How did you carry out that review?

20. Did you have to narrow students’ choices of ideas if they could not decide on one during their brainstorming of game concepts? If so, why?

21. What other forms of coaching and scaffolding (if any) were necessary for you to use in your instruction up to this point in the process?

Assessments-feedback
22. Up to this point in the process, I observed continuous use of formative assessments, self and peer assessments within and beyond groups with feedback loops. Are these types of assessments part of your pedagogical strategies in teaching social studies?

23. Was the use of these forms of assessments more intense than normal during the process, so far?

24. Did you need to use these forms of assessment-feedback loops as continuously as you did because of that game design and building context?

25. If so, why do you think that kind of frequency was necessary in this context?

26. I also observed, so far, that you utilized formative assessments, the blog, videos, group share and rubrics for students’/groups’ reflection or to assess students’ progress. Was there a need to use such a variety in this process? If so, Why?

27. Are you making greater use of technologies in assessing student progress? If so, why?

28. Up to this point in the process, how do you assess your instructional progress? How do you assess whether it’s effective in assisting students in their deep learning of the curriculum content, and their progress in successfully designing their video games?

29. Did you use the results of the assessments to make changes to the tasks’ activities and to your instruction, up to this point? If yes, how? If no, why not?
30. How did you use the results of the assessments to make changes to subsequent tasks’ activities and to your instruction? You can use an example from one of the tasks’ activities, such as developing game concepts, storyboarding, group dynamics, etc.

**Session 2**

**Deep learning**

1. Based on your observations during the process, so far, was there evidence of deep(er) learning on how the citizens in students’ various models participated in the government decision-making process? If so, please give some examples.

2. In your instruction, what are some of the strategies that you needed to use to encourage that deeper learning on how the citizens in students’ various models participated in the government decision-making process?

3. In designing the game concept and storyboarding tasks’ activities, what provisions did you think were needed to be made to encourage a deeper learning on how the citizens in students’ various models participated in the government decision-making process?

4. In your experience, so far, in what ways have you observed the process has positively encouraged your students’ deeper learning on how the citizens in students’ various models participated in the government decision-making process?

5. In what ways, did it not encourage deeper learning on how the citizens in students’ various models participated in the government decision-making process?

**Twenty-first Century Competencies**

1. Based on your observations during the process, so far, was there evidence of students’ development of 21st century competencies? If so, please give some examples.

2. In your instruction, what are some of the strategies that you used to encourage the continued development of these competencies (by 21st century competencies, by that I mean [list items from protocol])?
3. In designing the game concept development and storyboarding tasks, what provisions did you think you needed to be made to encourage students’ continued development and use of 21st century competencies?

4. In your experience, so far, in what ways have you observed the process has positively encouraged your students’ development of 21st century competencies?

5. In your experience, so far, in what ways have you observed the process has negatively impacted your students’ development of 21st century competencies?

**Intellectual Engagement**
1. Based on your observations during the process, so far, was there evidence of intellectual engagement of your students (by intellectual engagement, by that I mean [list items from protocol])? If so, please give some examples.

2. In your instruction, what are some of the strategies that you used to encourage their intellectual engagement?

3. In designing the game concept development and storyboarding tasks, what provisions did you think were needed to be made to encourage students’ intellectual engagement?

4. In your experience, so far, in what ways have you observed the process has positively encouraged the intellectual engagement of your students?

5. In your experience, so far, in what ways have you observed the process has negatively impacted the intellectual engagement of your students?

**Progress and moving forward**
1. So far, which task(s) of the process has/have proven most challenging to you in terms of your instruction? Why?

2. What did you do to overcome these challenges?
3. In the design of your instruction and tasks’ activities using this game design and building context/strategy, what learning theories guided your designs?

4. In moving forward to the programming task, what do you think you may need to change (if anything) in terms of your instruction to ensure that the students are intellectually engaged, are learning the curriculum content at a deeper level and are continuing to develop and use 21st century competencies?

Thank you!
Mid-interview FOR STUDENTS

School: Charter School

Date: April 29 and May 2, 2014

Goal of mid-interview

To discover through students’ experiences, the impact of students’ design and building of their video games on their intellectual engagement, deep learning of government decision-making process and development and use of 21st century competencies up to the storyboarding task.

Introduction

1. How do you feel about the game project, so far?

Intellectual engagement

1. Are you interested in learning about your chosen topic through the activities given by your teachers in this game design and building project? If so, why?

2. Do you think that these activities and this project are helping you to learn about the decision-making process in real life scenarios? If so, how?

3. Are they helping you to compare how the Athenians/Iroquois made decisions and how we are making decisions, today? If so, how?

4. During the process, so far, are you completely involved, focused and concentrating on your tasks’ activities? If so, give me some examples of how you are completely involved, focused and concentrating on your tasks.

5. Are you enjoying the project? If so, how?

6. Is the process, so far, helping you to have more fun whilst you are learning? If so, give me some examples of your fun experiences. If not, why aren’t you having fun?

7. During which task(s) have you had the most fun, so far? Why?
8. Whilst you were working on your game concepts and storyboards, were you aware of the amount of time you were spending on them?

9. Did you lose track of time? Explain!

10. Did you ever wanted to stop working when your teacher asks you to? If no, why? If yes, why?

11. Did you ever feel bored whilst you were working on your game concepts and storyboards? If so, why? If not, why?

**Deep Learning of content**

1. Do you think that you are learning about your topic at a deeper level than you would do if you were preparing a presentation, for example? If so, why?

2. In what ways do you think this game design and building project is helping you to learn and understand the government decision-making process at a deeper level so far?

3. During which task, so far, do you think you are gaining a deeper understanding of the government decision-making process?

4. What do you think about the feedback you get from your teacher? How is it helping you?

5. What do you think about the feedback you get from your group members and from other groups? How is it helping you?

6. As you are developing your game concepts and storyboarding them, are you learning about the government decision-making process in more creative ways? Give me some examples.

7. How are the reflections in your blogs and videos helping you during this project, so far?

8. Is the project, so far, helping you to connect what you are learning to real life situations or modern day occurrences? If not, why?
9. Did you find that developing your game concepts and storyboarding them very challenging and to some extent frustrating?

10. What was most frustrating and challenging for you? Why?

**Development of 21st century competences**

1. During this project, you are working in groups. Do you think that working in your group is helping you to learn and understand the government decision-making process at a deeper level than if you were learning it on your own? Why?

2. In your collaboration with your teacher, do you think that you are learning and understanding the government decision-making process at a deeper level? Why?

3. So far, is the project helping you to communicate better with your peers? If not, why?

4. So far, how is the project helping you to communicate better with your peers?

5. So far, is the project helping you to collaborate, cooperate better with your peers? If not, why?

6. So far, how is the project helping you to collaborate better with your peers?

7. So far, do you think your decision-making skills have improved as you are participating in this process? Why?

8. So far, do you think your debating skills have improved as you are participating in this project? Why?

9. So far, during the project, do you collaborate, communicate and cooperate more with your teachers than you would normally do in your social studies classes?

10. So far, during the process, do you collaborate, communicate and cooperate more with each other and other groups than you would normally do in your social studies classes?

**Thank you!**
Appendix I

Grade Six Teachers’ and Students’ Post Interviews

Post Interview FOR TEACHERS

School: Charter School

Date: June 19, 20

Goal of post interview

To find out what teachers needed to do (differently) in their design of instruction and learning tasks’ activities, while they accommodated a game design and building context/strategy in the classroom.

1. During the programming task, I observed that you used a more hands-off approach with the students compared to the previous tasks. Why?

2. Now that you have implemented all the learning tasks, what were the major shifts you attempted to accommodate in designing your instruction in this game design and building context to help the students learn about the government decision-making process at a deeper level?

3. What were the major shifts you attempted to accommodate in designing the learning tasks’ activities in this game design and building context to help the students learn about the government decision-making process at a deeper level?

4. Based on these shifts and as you implemented the learning tasks, did this context/strategy significantly impact how deeply student were learning the curriculum content? If so, how?

5. In which of the learning tasks, do you think deep learning of the curriculum and other possible content was most evident? Why?

6. In which of the learning tasks, do you think deep learning was least evident? Why?
7. As you implemented each learning task, did this game design and building context/strategy significantly impact how students were being intellectually engaged as they participated in the tasks’ activities? If so, how?

8. In which of the learning tasks do you think intellectual engagement was most evident? Why?

9. In which of the learning tasks do you think intellectual engagement was least evident? Why?

10. As you implemented each learning task, did this game design and building context/strategy significantly impact how students were developing and using 21st century competencies as they participated in the tasks’ activities? If so, how?

11. Which of these competencies did you see being most developed? Which of these competencies did you see being least developed?

12. In which of the learning tasks do you think students’ development and use of 21st century competencies were most evident? Why?

13. In which of the learning tasks do you think students’ development and use of 21st century competencies were least evident? Why?

14. In the design of your instruction and tasks’ activities in this game design and building context/strategy, what has changed for you in terms of learning theory or theories for teaching your students social studies?

15. In planning and utilizing this game design and building context/strategy to help the students learn about the government decision-making process, did you encounter any difficulty in tying this to the curriculum? If so, what did you need to do or did to ensure that the curriculum accommodated this context/strategy?
16. Did this context/strategy significantly change your classroom management style or leadership role? If so, how?

17. Did this context/strategy impact your teacher–learner relationship with the students? If so, how?

18. During the implementation of the learning tasks, what kinds of challenges, if any, did you encounter?

19. What do you think was most significant for you as a teacher in using this game design and building context/strategy to teach the government decision-making process?

20. What do you think was most significant for your kids in using this context/strategy to learn about the government decision-making process? Did it help you to learn more about how your students learn?

21. If you had to use video game design and building again to teach, what would you change? Why? What would you leave the same? Why?

22. What do you think about using video game design and building as an instructional strategy or pedagogy in any future classes to help students learn core curriculum content?

Thank you!
Post-interview FOR STUDENTS

School: Charter School
Date: June 19, 20

General

1. Now that you have participated in this project, how do you feel about the use of this video game design and building experience to help you learn about the government decision-making process? What’s your honest opinion about it?

2. Did this project allow you to learn the way you wanted to learn? How?

3. Did this project help you to learn and understand your topic at a deeper level? If so, how?

4. Do you think you will remember what you learned at least a year from now? Why?

5. Apart from the curriculum content, what other content and skills did you develop as you participated in this project?

6. Did your group complete at least the first prototype of your game? If not, why?

7. About how much more time would you need to complete the first prototype of your game?

8. Which learning tasks did you find most enjoyable and interesting? Why?

9. Which learning tasks do you think allowed you to learn about the government decision-making process in your various models at a deep level? Why?

10. Did you ever lose interest during your participation in the learning tasks? If so, why?

11. If you had to use this game design and building context/strategy again, what would you change, if anything?

12. How will that experience you have just gone through help to prepare you for your future?
**Intellectual Engagement**

12. How did this game design and building context/strategy help you to be more interested in learning about your chosen topic?

13. How did the activities help you to use your skills (art, music/sound engineering, story writing, programming, leadership) and abilities to learn the curriculum content at a deeper level?

14. Do you think that these activities in this project help you to see the relevance in what you were learning in real life situations? How?

15. As you participated in the learning tasks’ activities, did you ever go off task or was bored? If so, why?

16. Was the whole process a fun or enjoying experience for you? If not, why?

17. Did you at any time wanted to stop working on your project? If so, why?

18. Did the use of various technologies help you to be more engaged and interested in the learning of the government decision-making process in your various models? How?

19. Did the use of various technologies help you to enjoy what you were learning and creating as you participated in the learning tasks? How?

**Deep Learning**

1. During which learning task do you think you gained a deeper understanding of the government decision-making process in your model? Why?

2. In what ways did this project help you to learn and deepen your understanding of the government decision-making process in your model?

3. Did it encourage you to create and build/construct ideas that would help you to learn and deepen your understanding of the government decision-making process in your model? How?
4. Did it help to sharpen your research or inquiry skills? How?

5. Did it help you to think critically about the government decision-making process in your model? If so, give some examples.

6. Did the interaction with your teacher help you to understand the government decision-making process in your model at a deeper level? If so, give some examples.

7. Did the interaction with your teacher help you to reflect on the government decision-making process in your model from different perspectives? If so, give some examples.

8. Did the interaction with your teacher help you to understand your tasks’ activities? If so, give some examples.

9. What did you think of the absence of your teacher during the programming stage of your game?

10. How did it impact the building of your game prototypes during the programming task?

11. Did you think that the programming of the game helped you to learn and understand the government decision-making process in your model at a deeper level? How? If not, why?

12. How did the feedback you got from your group members and from other groups help in the programming of your games?

13. Did the interaction with your peers help you to understand the government decision-making process in your model at a deeper level?

14. Did the interaction with your peers help you to reflect on the government decision-making process in your model from different perspectives? How?

15. Did your participation in the tasks’ activities help you to use your research to solve your own decision-making problems, creatively? How?
16. Did the process help you to connect what you are learning to real life situations or modern day occurrences? If not, why?

17. Did you find that programming the game concept was very challenging and to some extent frustrating? Why?

18. Throughout the whole project, what was most frustrating and challenging for you? Why?

19. How did the reflections in your blogs help you during the project?

20. Did the use of various technologies help you to learn and understand the government decision-making process in your model at a deeper level? How?

Development and use of 21st century competencies

1. During the tasks’ activities, you worked in groups and with your teacher. Did this collaboration help you to learn and understand the government decision-making process in your model at a deeper level, than if you had attempted to learn about it on your own? Why?

2. Did this collaboration help you to enjoy your experience with designing a video game, and learning about the government decision-making process in your model?

3. Now that you have participated in all the learning tasks, did the communication, collaboration, and cooperation between you and your peers and you and your teacher improve? If not, why?

4. How did your participation in the learning tasks help to improve the communication collaboration, and cooperation between you and your peers; you and your teacher?

5. Now that you have participated in all the learning tasks, do you think your decision-making skills have improved? If so, how?

6. Do you think your problem-solving skills have improved? If so, how?
7. Did your participation in the learning tasks’ activities help to improve your creativity skills? How?

8. Did your participation in the learning tasks’ activities help to improve your research skills? How?

9. Did your specific roles help you to manage your responsibilities effectively? How?

10. Did your specific roles help to strengthen your group? How?

11. How will that experience you have just went through help to prepare you for your future?

Thank you!
Appendix J

Teachers’ Game Design Unit Plan

Grade 6 Gaming Project

Unit Ingredients

Scratch

Social Studies

Group Work

Research Skills
Self Reflection

Unit Game Plan

Stage One: Choose a Topic
- Choose a decision making method: Consensus, Representative Democracy, Majority & Plurality Voting
- Choose a decision making model: Inquiries, Municipal & Provincial, Ancient Athens
- How did the citizens participate in the decision making process?

Stage One: Choose a Topic
- Choose a decision making method: Consensus
- Choose a decision making model: Ancient Athens
- How did the citizens participate in the decision making process?

Stage Two: Digging Deep
- Every good inquiry begins with good questions
- What does your group need to know about your choice?
- These questions will guide the research you conduct
- Where will your group conduct this research?
- Ms. F and Mr. M will be assessing the quality of your Q’s & research
- If your research is deemed “sufficient”, you will move to the next stage
- What other interesting tidbits did you learn along the way? (for extra credit)

Today’s game plan: Decide
- Assemble in your groups
- Review the choices of topic
- Make some decisions
- Have your decisions approved by teacher
- Blog about the decisions your group made

Questions?
Today’s game plan: Research

- You have chosen your topic.
- Ask yourself, “So, what do we need to go find out?”
- Create your guiding questions that will drive your research.
- Everyone becomes a researcher (5 heads are better than one).
- Hoop your research findings in Google Drive/Presentation.

Guiding Questions

- What are they?
  - Guiding questions are crucial and vital to conducting research.
  - Without them, your research becomes a “Wild Goose Chase.”
  - They are based on what your overall goal is.
- What are they not?
  - Basic “Yes or No” questions.
  - Easy to “Google.”
  - Impossible to answer.

Example of Guiding Questions:

- **Scenario:** Mr. M & Ms. L are researching the Connect model of decision making.
- What will they need to ask in order to become experts?

- Who works at Connect?
- What is the process used in the process?
- What type of decision is made?
- What happens when it’s decided and populated?

By asking these questions, our research findings will be meaningful.

Today’s game plan: Research

- Assemble in your groups.
- Create a Google Doc/Presentation.
- Create the questions that will guide your group’s research.
- Also, be sure to keep a list of tasty tidbits of info for your “world.”
- Submit the Questions through Edmodo (Assignment).
- Compile the research.

Questions?

Today’s game plan: Reflection

- Reflection Time: How did you perform? How did your group members perform?
- Your group has compiled a body of research.
- Take time to reflect on this process.
- How did the members of your group perform during this stage?
- What attributes should we consider when providing feedback?
- There are 4 important attributes we will be considering!
Let’s reflect!

Gaming Unit - Reflection #1

Your name: ____________________
Date: ____________________

Self Reflection

Cooperation: __________

Communication: __________

Collaboration: __________

Contribution: __________

Is each group member “pulling their weight?”

Do your group members participate in the process?

Do your group members express their ideas?

Do your group members share the same goal?

Do your group members combine ideas to create stronger ones?

Do your group members listen to and consider the ideas of others?
What’s the Story?

- You have compiled a body of research on your chosen topic.
- So, now what?
- Your group will need to brainstorm possible stories.
- The stories are born out of your research.
- Choose the story with the most game potential.
- How do you know your game idea is a great one?

Guide to a Great Game Creation

- Every great game begins with a great story.
- Your game needs a gripping problem and a creative solution.
- Your story requires an interesting character(s).
- Your story takes place in a rich environment (setting).
- Your story is respectful of the topic.

Every great game has the following elements:

- Your game is challenging and has a “Flow.”
- The mechanics are ________
- Simple is better.

Finalizing Game Concept

- Be sure to consider all potential game concepts.
- When your group has decided on a concept, it’s time to plan.
- Every member is involved in this step of the process.
- Be aware of what is possible vs. what is impossible.
- A storyboard will be a crucial tool in creating your game.
Appendix K

Curriculum Content for the Intervention

Subject Area: Social Studies

Topics:
Curriculum Goals and Objectives:
General Outcome 6.1: Citizens Participating in Decision Making
Students will demonstrate an understanding and appreciation of the dynamic relationship between governments and citizens as they engage in the democratic process.

General Outcome 6.2: Historical Models of Democracy: Ancient Athens and the Iroquois Confederacy
Students will demonstrate an understanding and appreciation of the democratic principles exemplified by ancient Athens and the Iroquois Confederacy.

Citizens Participating in Decision Making

Topic 1 Content:
Recognize how individuals and governments interact and bring about change within their local and national communities:
- recognize and respect the democratic rights of all citizens in Canada (C, I)
- value the role of the Canadian Charter of Rights and Freedoms in protecting individual and collective rights and freedoms (I, PADM)
- recognize the influence of historical events and legislation on democratic decision making in Canada (TCC, PADM)
- value citizens’ participation in a democratic society (C)
- value the contributions of elected representatives in the democratic process (PADM)

Topic 2 Content:
Demonstrate an understanding of the fundamental principles of democracy by exploring and reflecting upon the following questions and issues:
- What is democracy (i.e., justice, equity, freedoms, representation)? (C, PADM)
- What are the similarities and differences between direct and representative democracy? (PADM)
- What are the rights and responsibilities of citizens living in a representative democracy? (C, PADM)
- How does Canada’s justice system help protect your democratic and constitutional rights? (C, PADM)

Topic 3 Content:
Analyze how the democratic ideals of equity and fairness have influenced legislation in Canada over time by exploring and reflecting upon the following questions and issues:
- How does the Canadian Charter of Rights and Freedoms protect the individual rights and freedoms of all Canadians? (I, PADM)
- How does the Canadian Charter of Rights and Freedoms protect collective rights in Canada (i.e., Aboriginal rights, the linguistic rights of official language minorities)? (I, PADM)
• How did the Treaty of La Grande Paix de Montréal address collective identity and collective rights? (I, PADM, TCC)
• How do the Treaty of La Grande Paix de Montréal and the Canadian Charter of Rights and Freedoms compare in the way that each addresses individual and collective identity and collective rights? (PADM, TCC, I)
• Why is the Canadian Charter of Rights and Freedoms entrenched in the Canadian Constitution? (C, I, PADM)

**Topic 4 Content:**
**Analyze the structure and functions of local governments in Alberta by exploring and reflecting upon the following questions and issues:**
• How are representatives chosen to form a local government (i.e., electoral process)? (PADM)
• What are the responsibilities of local governments (i.e., bylaws, taxes, services)? (PADM)
• How are local governments structured differently in rural and urban settings? (PADM)
• What role is played by school boards (i.e., public, separate, Francophone) within local communities? (PADM)

**Topic 5 Content:**
**Analyze the structure and functions of Alberta’s provincial government by exploring and reflecting upon the following questions and issues:**
• How is the provincial government structured? (PADM)
• What is the role and status of the Lieutenant Governor within the provincial government? (GC, PADM)
• What are the responsibilities of the provincial government (i.e., laws, taxes, services)? (PADM)
• How are representatives chosen at the provincial level of government (i.e., electoral process)? (PADM)
• What are the differences between the responsibilities of a Member of the Legislative Assembly (MLA) and a cabinet minister? (PADM)

**Topic 6 Content:**
**Analyze how individuals, groups and associations within a community impact decision making of local and provincial governments by exploring and reflecting upon the following questions and issues:**
• How can individuals, groups and associations within a community participate in the decision-making process regarding current events or issues (i.e., lobbying, petitioning, organizing and attending local meetings and rallies, contacting elected representatives)? (C, PADM)
• How do associations such as the Association canadienne-française de l’Alberta (ACFA), the Métis Nation of Alberta Association (MNAA) and the First Nations Authorities (FNA) provide their members with a voice, at local and provincial levels, exercising historical and constitutional rights? (C, I, PADM)
• In what ways do elected officials demonstrate their accountability to the electorate (e.g., respond to constituents, participate in local events, represent and express in government meetings the concerns of constituents)? (C, PADM)
Historical Models of Democracy: Ancient Athens and the Iroquois Confederacy

**Topic 7 Content:**
Analyze the structure and functions of the democratic system in ancient Athens by exploring and reflecting upon the following questions and issues:

- How was the government of ancient Athens structured? (PADM)
- How did the structure of the government in ancient Athens provide opportunities for citizens to participate in decision making? (C, PADM)
- How did identity, status and class structure impact citizenship in ancient Athens? (C, I)
- How did the social structure of ancient Athens impact its political structure? (CC, PADM)
- To what extent were democratic ideals of equity and fairness part of the structure of government and society in ancient Athens? (I, PADM)

**Topic 8 Content:**
Analyze the structure and functions of the Iroquois Confederacy by exploring and reflecting upon the following questions and issues:

- How was the Iroquois Confederacy structured? (PADM)
- What was the role and status of women within the Iroquois Confederacy? (I, PADM)
- What are the advantages and disadvantages of consensus as a decision-making model for government? (PADM)
- How did the Six Nations use the consensus-building process? (PADM)
- How did the Wampum Belt address collective identity? (I, PADM)
- How did the social structure of the Iroquois Confederacy impact its political structure? (CC, PADM)
- To what extent did the decision-making process within the Iroquois Confederacy reflect democratic ideals of equity and fairness? (PADM)

<table>
<thead>
<tr>
<th>C</th>
<th>Citizenship</th>
</tr>
</thead>
<tbody>
<tr>
<td>ER</td>
<td>Economics and Resources</td>
</tr>
<tr>
<td>CC</td>
<td>Culture and Community</td>
</tr>
<tr>
<td>I</td>
<td>Identity</td>
</tr>
<tr>
<td>LPP</td>
<td>The Land: Places and People</td>
</tr>
<tr>
<td>GC</td>
<td>Global Connections</td>
</tr>
<tr>
<td>PADM</td>
<td>Power, Authority and Decision Making</td>
</tr>
<tr>
<td>TCC</td>
<td>Time, Continuity and Change</td>
</tr>
</tbody>
</table>

Alberta Education (2007)
Appendix L

Example of Completed Reflected Rubric
Hey boys,
Thanks for the chat about how things are going so far in terms of your group skills. Things seem to working really well and everyone identified a variety of strong group skills on M’s part. Well done, M I am attaching a photo of the conversation ‘doodle’ I made during our chat. I think it highlights the key points of our discussion. We talked about what true collaboration means as well how to draw a reluctant communicator into the discussions. Both of these areas are critical to maximizing the performance of the group. I look forward to our next chat and hearing what changes have occurred.

Hi Ladies,
Our chat was enjoyable. We discussed what makes someone a ‘pleasure’ to work with. All of you were rated ‘a pleasure to work with’ by at least one other group member. That’s awesome! Keep being cooperative with each other. We also talked about how it is important for those ‘Star’ group members to sometimes hand some of the control over to the other group members. I used an example of a star soccer player ‘hogging’ the ball because they know they have the skills to get the job done! In this group exercise, it is important for everyone to have an equal opportunity to be the star, so spread it around! I was very pleased to hear that your ideas are not simply be shared, but that you are trying to combine elements of everyone’s ideas into the project. That’s true collaboration. Do you remember my snowballs vs. snowman metaphor? Here’s a photo to remind you:

Hi Group 3,
I enjoyed our chat about your self and group reflections. The big point of our talk was centered around what true collaboration looks like. It doesn’t look like a single idea from one member that everyone decides is the best. It is when each person has contributed in some way to the overall goal. That’s when truly collaborative ideas are born. Here's the drawings I did to help you see what that ‘looks like’. I look forward to our next reflection chat.

Hi Group 4,
Thanks for sharing your impressions of your group’s performance to this point of the assignment. Things seem to be working well for this group. During our chat we attempted to explain two questions; 1. How do you spread the ‘air time’ around? and 2. What makes someone a pleasure to work with. Remember, it is important to engage ALL group members and not just the ideas of those who are most comfortable with taking on a leadership role. There are a lot of skills spread between your group member, so just do your best to let everyone chip in.

Hi Group 5,
Thanks for your self and peer reflections. I enjoyed our follow-up chat and think it was great that we took the time to really analyze what skills make someone a pleasure to work with. You seem to feel that, generally, everyone is ‘OK’, so the challenge will be to boost your performance to the next level. Be considerate of each other’s ideas and feelings while building ideas through the individual contributions people are making.
Hello ladies,
I enjoyed our discussion focused on your group’s performance to this point of the assignment. Things do seem to be working quite nicely for you all. S is one of the only students to receive the highest overall mark for cooperation, so she must be doing something right. Learn from her. She has great cooperation skills so she is someone you want to learn from. My question to you all is, how do you deal with a group member who isn't as skilled or experienced with getting their points across? It can be tough to do for some kids in a group setting. How do you encourage them to share their ideas when they seem reluctant? After all, it's important to get everyone contributing.

Hi Group 3,
Thank you for providing your self and peer reflections. After crunching the ‘data’ it becomes apparent that this group is having difficulties making every member feel like their ideas and contributions are being considered. A productive group finds a way for all members to feel heard. It is not acceptable to ostracize a member of the group because their ideas don't match the majority. At the end of the day, this assignment’s greatest goal is to teach everyone what it takes to be a positive and productive member of a group. Sometimes, our ideas are not used, but no one likes to feel like their ideas don’t matter. Your challenge is to find a way to honor and respect each member's contributions regardless of whether they are used in the project. This is going to be something I’ll be keeping my eye on. Remember, ideas really matter to the person who created them and that needs to be respected and considered. Even when the idea doesn’t work for the group, there needs to be a level of consideration given to that idea.

Hi Group 5,
It seems like things are working pretty nicely for this group. After chatting with you, I want to ask you this question: how do you deal with a member of a group when they make cut you off from making your point? It’s a tough situation, but you are at an age where these skills become very important. Do you just give up? Do you start a fight? What's the best way to deal with something like that?
### Appendix N

**Frameworks for the Design and Implementation of the Intervention in the Prototyping Phase of DBR Process**

Table 9


| Framework for the Design and Implementation of the Design and Building of Digital Video Games |
|---|---|---|
| **Phases** | **Stages** | **Time** |
| **Phase 1:** Familiarization and practice with game | ▪ Training in the use of software (Scratch) by both students and teachers | 2 weeks |
| | ▪ Training and practice for both teacher and student participants to acquire knowledge and skills in creating digital video games (mini-games) | 3 weeks |
| **Phase 2:** Planning | ▪ Define goals that help student participants to specify the domain knowledge of the game | 3 weeks |
| | ▪ Identify the necessary content that student participants need to know to solve their designed problems |  |
| | ▪ Form game-design and building teams (story writer, artist, programmer, audio specialist, leader) |  |
| | ▪ Find possible contexts that might be appealing for the potential audience of the digital video games |  |
| | ▪ Teams select a real life situation(s) that embed the content and the context defined in the previous steps |  |
| **Phase 3:** Crafting (iterative) | ▪ Story drafted from specified content and for specific contexts | 3 weeks |
| | ▪ Problems to be solved in story/content designed |  |
| | ▪ Artwork drafted to support story/content in specific contexts |  |
| **Building core mechanics** (iterative) | ▪ Prototype design informed by Mellini, Talamo and Giorgi’s (2010) educational characteristics of gaming aspects of game design | 6 weeks |
| | ▪ Content integrated informed by Mellini, Talamo and Giorgi’s (2010) characteristics of the learning aspects of game design |  |
| | ▪ Content refinement |  |
| | ▪ Prototype refinement |  |
| **Phase 4:** Analyses and Evaluation (iterative) | ▪ Conduct a series of analyses to confirm whether initial ideas and models have the potential to propose solutions to the designed problems | 4 weeks |
| | ▪ Ensure that the game situation(s) matches the proposed content and the potential players’ skills level |  |
| | ▪ Based on the affordance and correspondence analyses, student participants make the necessary changes and present the final design of the game |  |
| **Phase 5:** Packaging | ▪ Teachers design and develop rubrics to corroborate the learning process involved in student participants’ games to intellectually engage them in deep learning of the content provided and their acquisition of core 21st century competencies | 4 weeks |
As a self-evaluation process, student participants reflect on the processes that they were involved in, learning experiences, and on the final design of the game as a solution to the designed problem(s).

Confirm that each of the core and the processing components successfully support one another.

**Initial Teachers’ Tasks:**

1. Teacher participants will receive training and practice in the use of chosen software (Scratch) to acquire knowledge and skills in creating digital video games (mini-games).

2. During the planning stage of the intervention, the teacher participants will identify and define the content-specific learning goals that will inform the chosen content that the students should know for the proposed games they will design and build.

3. They will then identify the content that the student participants should know to solve their designed problem(s), the teacher participants will consider the scope, breadth and depth of the problem(s) that will be solved in the chosen concepts through the learning goals and objectives of the curricular or program of studies.

4. Using short teaching sessions, they will teach student participants how they should think about the content of the concepts before making their stories and embedding them into the design of their games.

5. The teacher participants will also align student participant design ideas with the specified content of the selected concepts as addressed in the curricular standards or program of studies so that student participants can study the content and think critically about it in order to embed it in their stories in the games.

6. The teacher participants will manage the formation of the game-design and building teams (story writer, artist, programmer, audio specialist, leader) within which the student participants will work. They will assist the students in finding possible contexts that might
be appealing for the potential audience of the digital video games. As part of the context, teacher and student participants will also define the target audience of the game and the conditions under which the potential game will be played.

7. The teacher participants will provide the student participants with opportunities to critically think about connecting their content knowledge or their stories with the context to better understand the concept they want to implement in their games.

8. The various teams and teacher participants—functioning as facilitators and content experts will hold meetings (as needed) to exchange opinions and ideas in order to find possible solutions based on the chosen content and the context for their games. During these meetings, the teacher participants will also provide student participants with opportunities to deviate from the intended content area (provided by the teacher participants) and the context of the designed problem(s) for more information to help solve the problem(s). They will also allow them to play recommended games that will help them to evaluate the strengths and weaknesses of the games in terms of the connection between required content and contexts.

9. During the crafting and building core mechanics phase of the intervention, while students are crafting their games, the teacher participants will function as content and design experts, ensuring that the learning aspects of the game-design process and the gaming and technical aspects of the design identified in the review of the literature are employed.

10. During the analysis and evaluation phase, the teacher participants will assist the student participants, in “conducting correspondence [analyses]” to evaluate whether the chosen problem situation(s) for their games corresponds to the intended content covered, the learning goals and objectives of the curricular or programs of study used for the specified content knowledge, provide accurate context that will help potential players to connect
content into contexts and concepts into conceptual frameworks and the skill level of the students (Goodnough & Hung, 2008, p. 68).

11. The teachers will conduct these correspondence analyses by examining: “1) whether the problem properly affords or supports the learning goals, 2) whether the key knowledge involved in solving the problem matches the intended content knowledge, 3) whether the contextual information in the problem is sufficient to situate the learning in an authentic context, or 4) whether the connection component of the problem is properly designed” (Goodnough & Hung, 2008, p. 68).

12. The teacher participants will also assist the game design teams to carry out an evaluation of their final products to find out whether they solved the designed problem(s), matched the proposed curricular goals, content and the potential players’ skills level by reflecting on their analyses results and testing them with their peers.

13. Teacher participants will design and develop lesson plans, assessment rubrics (in collaboration with their students) to corroborate the learning process involved in their student participants’ games as well as the extent to which the student participants were intellectually engaged in deep learning of the content provided and their acquisition of core 21st century competencies.

14. When implementing the intervention, the teacher participants will collaborate with the researcher to choose the game software that will be used to develop the games and the specific Social Studies content that will meet the curricular goals to be explored in the game, to modify the design (including phases and tasks) of the intervention, and its enactment and implementation.

15. Teacher participants will also blog detailed field notes on the implementation process, instructional procedures, game-building process, student intellectual engagement, deep
learning of content, 21st century competencies, student and teacher attitudes and emotions, amount of time taken to design learning tasks, perform tasks and complete the tasks, frequency of various behaviors and activities, sequencing of the behaviors and activities, problems that occur, anomalies, “all the complexities, all the errors . . ., open, sharing and critiquing, constantly re-examining, looking at things from different perspectives. . . documenting everything that occurs, . . . all the compromises that have been made. . .” and any other relevant experiences (Reeves, 2011, Video file).

**Initial Students’ Tasks:**

1. Training and practice in the use of chosen software (Scratch) to acquire knowledge and skills in creating digital video games (mini-games).

2. During the planning phase, the student participants will form their game-design and building teams (story writer, artist, programmer, audio specialist, leader) and with the assistance of the teacher participants will decide on the possible contexts that might be appealing for the potential audience of their games. As part of the context, student participants will also define the target audience of the game and the conditions under which the potential game will be played.

3. Student participants will be guided to design and build their games with an absence of violent activities. With little or no help from the teacher participants, student participants (having formed their teams) will discuss the different options that they think will be suitable real life problems for the potential players of their games. Student participants will use given opportunities to critically think about connecting their content knowledge with the context to better understand the concept they want to implement in their games.
4. The various teams with the assistance of the teacher participants—functioning as facilitators and content experts will hold meetings (as needed) to exchange opinions and ideas in order to find possible solutions based on the chosen content and the context for their games. During these meetings, the student participants will use given opportunities to deviate from the intended content area (provided by the teacher participants) and the context of the designed problems for more information to help solve the problems. They will also play recommended games that will help them to evaluate the strengths and weaknesses of the games in terms of the connection between required content and contexts.

5. During the crafting and building core mechanics phase of the intervention, the stories representing the specified content in the games will be managed and drafted by the story writer in each team. The artist will manage and design the visual aspects of the game using high quality graphical elements, or by employing familiar objects to support the story/content in specific contexts. The game play and mechanics will be designed in this phase by the artist, audio specialist, programmer and editor. Using the designs created in the crafting phase, the development team comprising the story writer, artist, programmer, audio specialist and editor will build the games to specifications (Walsh, 2009).

6. During the analysis and evaluation phase, student participants, with assistance from the teacher participants, will conduct a series of correspondence analyses to confirm whether their initial ideas and models have the potential to propose solutions to their designed problems, to evaluate whether the chosen problem situation(s) for their games achieve the learning goals and objectives of the curricular or programs of study used for the specified content knowledge, provide accurate context that helps potential players to connect content into contexts and concepts into conceptual frameworks and their skill level.
7. The game design teams, with the assistance of the teacher participants will carry out an evaluation of their final products to find out whether they matched the proposed content and the potential players’ skills level by reflecting on their analyses results and testing them with their peers.

8. In addition, student participants will be allowed to document or blog or video tape their experiences while designing and building their games.
Teachers’ Initial Framework for the Design and Implementation of the Intervention in the Prototyping Phase of the DBR Process

Grade 6 Gaming Unit

Unit Synopsis
This unit was developed in conjunction with a University of Calgary research project looking at the potential impact of video game design as an instructional strategy in the classroom. Students work in groups to develop a video game that will support and enhance their understanding of components of the Alberta Social Studies Program of Studies.

Unit Focus Areas
- Inquiry
- Social Studies
- Collaboration
- Self-reflection

Game Design
Students will use the Scratch software to develop a video game that gives the player a fun and informative experience. Based on the information learned through this . . .

What do we want students to learn?
General learning outcomes of this unit are as follows:
6.1.1: recognize how individuals and governments interact and bring about change within their local and national communities
6.1.2: demonstrate an understanding of the fundamental principles of democracy
6.1.5: analyze the structure and functions of Alberta’s provincial government

Game Creation
With a solid plan in place, students move into their individual roles and work to bring the concept to fruition. How effective and creative each student is in their efforts will be assessed by their peers as well as their teacher.

The Pitch
Once the group has agreed on a storyboard, they “pitch” the concept to the teacher. Based on the feedback provided, students will either move forward with the game development or spend more time modifying their storyboards.

Organization
Students are divided into groups consisting of five members. Each member was assigned a specific role based on a survey circulated prior to the launch of the lesson. The five roles are:
- Team leader
- Artist
- Programmer
- Music director
- Story writer

Storyboarding
Groups create a visual plan of their game concept using any method of their choosing. These storyboards will provide each group member with a clear view of the overall vision and will enable them to work on different stages of the game simultaneously.

Choosing a topic
Each group has a choice of topic. They choose a decision-making method (consensus, representative democracy, majority and plurality voting) and a historical model of decision making (Ancient Athens, Iroquois Confederacy, current era). Once the group reaches a decision on their topic, they use their research skills to learn as much possible about that topic.

Game Concept
Here is where groups get creative. Knowing what they know about their chosen topic, they must develop a game concept that will demonstrate their understanding while providing the game player with a “learn as you go experience”.

Test Phase
Students and teachers will have the opportunity to interact with each game to provide the developers with feedback based on their experiences. Changes and modifications can be made at this time.

Assessment
Assessment is both formative and summative in this unit.
Collaborative Framework by Teacher Participants and Researcher to Guide the Design and Implementation of the Intervention in the Prototyping Phase of the Design-Based Research Process

<table>
<thead>
<tr>
<th>Phases</th>
<th>Stages</th>
<th>Time-frame</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase 1: Familiarization and practice with game mechanics and software (pre-requisite skills)</td>
<td>▪ Training in the use of software (Scratch) by both students and teachers</td>
<td>2 weeks</td>
</tr>
<tr>
<td></td>
<td>▪ Training and practice for both teacher and student participants to acquire knowledge and skills in creating digital video games (mini-games)</td>
<td>3 weeks</td>
</tr>
<tr>
<td>Phase 2: Planning</td>
<td>▪ Form game-design and building teams (story writer, artist, programmer, audio specialist, leader)</td>
<td>3 weeks (December 10-21); March 10-14</td>
</tr>
<tr>
<td></td>
<td>▪ Define goals that help student participants to specify the domain knowledge of the game</td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ Choose the topics that will inform their designed problems to solve in their games</td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ Identify content that student participants need to know and research to solve their designed problems</td>
<td></td>
</tr>
<tr>
<td>Phase 3: Crafting (iterative)</td>
<td>▪ Game concept</td>
<td>2 weeks (March 4-20, 2014)</td>
</tr>
<tr>
<td>Analyses, Reflection and Evaluation (iterative)</td>
<td>▪ Teachers design and develop assessment of group performance (rubrics); formative assessment; blog reflections, self and peer assessment (group performance) and provide feedback to corroborate the learning process involved in student participants’ game concept to intellectually engage them in deep learning of the researched content and their acquisition of core 21st century competencies</td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ Conduct correspondence analyses to confirm whether initial ideas and models from game concept have the potential to propose solutions to the designed problems</td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ Ensure that the game situation(s) matches the proposed content and game design principles</td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ Storyboarding</td>
<td>6 weeks (March 20-May 1, 2014)</td>
</tr>
<tr>
<td></td>
<td>▪ Problems to be solved in story/content design</td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ Find possible contexts that might be appealing for the potential audience of the digital video games</td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ Teams select a real life situation(s) that embed the content and the context defined in the previous steps</td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ Story to be drafted from specified content and for specific contexts informed by research</td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ Artwork to be drafted to support story/content in specific contexts</td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ Music/sounds to be created to support games</td>
<td></td>
</tr>
</tbody>
</table>
Teachers design and develop assessment of group performance (rubrics); formative assessment; blog reflections and provide feedback to corroborate the learning process involved in student participants’ games to intellectually engage them in deep learning of the content provided and their acquisition of core 21st century competencies.

- Conduct correspondence analyses to confirm whether initial ideas and models have the potential to propose solutions to the given problem.
- Ensure that the game situation(s) matches the proposed content and the game design principles informed by Mellini, Talamo and Giorgi’s (2010) educational characteristics of gaming, learning and technical aspects of game design.

**Phase 4: Building core mechanics (iterative)**

**Packaging** (Reflection and Evaluation)

- **Programming**
  - Prototype design informed by game design principles informed by Mellini, Talamo and Giorgi’s (2010) educational characteristics of gaming, learning and technical aspects of game design.
  - Content refinement
  - Prototype refinement
  - Ensure that the game situation(s) matches the proposed content and the game design principles.
  - Confirm that each of the core and the processing components successfully support one another.
  - Based on the correspondence analyses, student participants make the necessary changes and presented the final design of the game.

6 weeks
Appendix O
Examples of Students’ Storyboard and Game Prototype Artifacts

Examples of Storyboards

Visual storyboard for Ancient Athens Scratch Project

Visual storyboard for City of Calgary Municipal Voting System
Visual storyboard for *Slave Run*
Examples of Game Prototype 1

Video game prototype 1 scenes from City of Calgary Municipal Voting System
Scripting for scenes 1, 2, 5 (among others) in *City of Calgary Municipal Voting System Prototype 1*
Link to game prototype: http://scratch.mit.edu/projects/20850063/

Video game prototype 1 scenes from Athens Democracy
Scripting for scenes 1-4 in *Athens Democracy* prototype 1
Appendix P

Educator Consent Form

Informed Consent Letter for Teachers

Research Project Title: *Building digital video games at school: A design-based study of teachers' design of instruction and learning tasks to promote student intellectual engagement, deep learning and development of 21st century competencies*

Investigators: Deborah Gail Lambert

Sponsor: NA

Research Approval: The University of Calgary Conjoint Faculties Research Ethics Board has approved this research study.

Dear Educator:

This consent form, a copy of which has been given to you, is only part of the process of informed consent. If you want more details about something mentioned here, or information not included here, feel free to ask. Please take the time to read this carefully and to understand any accompanying information.

Purpose of the Research

To address one of the main concerns of teachers and administrators in many Canadian schools, that is, to find ways or instructional strategies to help their students learn the content of core academic subjects, while equipping them with 21st century competencies—new or innovative and different ways or instructional strategies that have the potential to challenge and intellectually engage them in deep, meaningful and authentic ways in the formal classroom context (Dunleavy & Milton, 2009). This will be done by using a design-based research approach to carry out a design experiment in a formal, public school classroom context to explore the potential of a chosen innovative intervention, the design and building of digital video games, as an instructional strategy—ensuring a focus on learning as opposed to teaching (C21 Canada, 2012) in an attempt to intellectually engage students in deep learning of content in core academic subjects and equip them with 21st century competencies.

Two primary research questions guide this research study: (1). In what ways do teachers’ design of instruction and learning tasks need to shift when designing and building digital video games to intellectually engage students in deep learning in formal classroom contexts? (2). In what ways does the design and building of digital video games in school impact students’ intellectual engagement, deep learning of core academic content, and the development of 21st century competencies?

What Will I Be Doing?

As a grade 6 humanities teacher, you are invited to participate in this design-based intervention. Your basic role in the research will include:

1. completing an online survey on video game experience before the implementation of the intervention *(The online survey is being administered by SurveyMonkey®, a web survey development cloud based (Software-as-a-Service) American company. As such, your responses are subject to U.S. laws, including the USA Patriot Act. The risks associated with participation are)*

458
minimal, however, and similar to those associated with many e-mail programs, such as Hotmail© and social utilities spaces, such as Facebook© and MySpace©)

2. training and practice in the use of chosen software (Flash or Scratch or AgentSheets) to acquire knowledge and skills in creating digital video games (mini-games)

3. designing learning tasks and instruction to intellectually engage students in deep learning when designing and building digital video games (An overview of your detailed tasks during the intervention is attached.)

4. collaborating with the researcher to choose the game software that will be used to develop the games and the specific core subject areas and content that will meet the curricular goals to be explored in the game

5. providing lesson plans, assessment rubrics, detailed field notes on experiences, observations and outcomes

6. participating in 30–60 minute interviews (pre-, mid- and post), individually—The interview will be audio-recorded and the audio recordings will be transcribed. If you opt to, you will not be identified in the final report but rather be referred to as “grade Y Teacher A”, for example.

7. permitting the researcher and/or a specially trained research assistant to enter your classroom to code the level of intellectual engagement, deep learning and development of 21st century competencies and teacher performance and behaviors using classroom observation protocols

As the video game design instructor, you are invited to participate in this design-based intervention. Your role in the research will include the provision of your game design expertise to the teacher and student participants. (An overview of your detailed tasks during the intervention is attached.)

As the professional development specialist, you are invited to participate in this design-based intervention. Your role in the research will include the provision of your technological expertise to the research team.

Dissemination of Findings
Findings of the study will be presented in a research dissertation, in partial fulfillment of the requirements for the degree of Doctor of Philosophy. Copies of the publications or other reports resulting from the research will be provided to the participating institution to inform future instructional strategies at the school. Findings will also be disseminated in presentations, conferences, professional associations and peer-reviewed publications. The school will be identified in the dissemination and reporting of findings.

With parental and teachers’ permission, students’ artifacts will be published online for interaction with other game communities from other schools.

What Type of Personal Information Will Be Collected?
Should you agree to participate, you will be asked to provide your gender and academic major.

<table>
<thead>
<tr>
<th>Gender</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>Academic major</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Other data that could be collected include:
- An online survey about your video game experience
- Audio-taped 30–60 minute individual interviews with you
- Video-taped sessions as you interact with students during the intervention (faces will not be focused on with your permission)
- Artifacts of your teaching and research contributions: lesson plans, assessment rubrics, detailed field notes on experiences, observations and outcomes
- Pictures of artifacts
• Observations in your classroom by researcher and/or a specially trained research assistant using classroom observation protocols

Due to the nature of recruitment and data collection, your participation in this research will be widely recognized by your students, the school principal and vice-principal, and by other teachers. There are several options for you to consider if you decide to take part in this research. You can choose all, some or none of them. Please put a check mark on the corresponding line(s) that grants me your permission to:

<table>
<thead>
<tr>
<th>Permission Requested</th>
<th>Yes:</th>
<th>No:</th>
</tr>
</thead>
<tbody>
<tr>
<td>I agree to have the researcher observe my teaching.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I grant permission for the researcher to use artifacts such as lesson plans, assessment rubrics, detailed field notes on experiences, observations and outcomes.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I grant permission to be <strong>audio-taped</strong> during the interview.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I grant permission to be <strong>video-taped</strong> during the sessions.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I grant permission to <strong>photograph</strong> artifacts during the sessions.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I grant permission to complete the online survey. Here is my email address – send me the survey URL.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I wish to remain anonymous, but you may refer to me by a pseudonym.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The pseudonym I choose for myself is:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>You may quote me and use my name.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

It is hoped that my presence, as a researcher, will not be too invasive to you or the students. I will always provide advanced notice of my arrival and will always be available to answer any questions you may have.

**What Happens to the Information I Provide?**

Your participation in this study is strictly voluntary. You have the option to discontinue your participation in the study at any time during the study. If you choose to discontinue participating in the study, the data collected from you, up to the point of your withdrawal, will be used in the analysis of the data.

Should you decide that your participation in the study remains anonymous, the information you provide will be kept confidential. To keep the information you provide confidential, you will only be identified by grade taught and your pseudonym. To ensure confidentiality of your data, all copies of field materials including journals or field texts, transcribed interviews, videos, pictures and artifacts containing identifying information will be stored in a locked draw to which only the researcher will have the key. All digital data will be encrypted and password allowing only the researcher to gain access to the data. All data will be held until August 2019 and will be subsequently destroyed. Paper data will be shredded and electronic data will be deleted and the hard drive erased.

The research intervention will begin from September 2013 and conclude in or before March 2014.
You will be consulted to set up the times and dates for any discussions on implementation of the intervention, classroom visits, findings, modifications or iterations to the intervention or other issues impacting the data collection process.

**Signatures – Written Consent**

Your signature on this form indicates that you understand to your satisfaction the information provided to you about your participation in this research project.

In no way does this waive your legal rights nor release the researcher or involved institution from their legal and professional responsibilities. You should feel free to ask for clarification or new information throughout your participation.

**Submitting this consent form**

After you have completed and signed this form, please seal it in the envelope provided, and drop it off in the box provided for this purpose in your classroom. The researcher will collect it from there.

School Name: __________________________________________________________________

Participant’s Name: (please print) ________________________________________________

Participant’s Signature: _______________________________ Date: ____________________

Participant’s Email address: ____________________________________________________

Researcher’s Name: (please print) Deborah Gail Lambert

Researcher’s Signature: ________________________________ Date: ____________________

Research Supervisor’s Name: (please print) Dr. Michele Jacobsen

**Questions/Concerns**

If you have any further questions or want clarification regarding this research and/or your participation, please contact:

Deborah Lambert

Dr. Michele Jacobsen, Doctoral supervisor

If you have any questions or issues concerning this research study that are not related to the specifics of the research, you may also contact the Research Services Office, University of Calgary at (403) 220-3782; email rburrows@ucalgary.ca

A copy of this consent form has been given to you to keep for your records and reference.
Appendix Q

Parent/Child Consent Form

Informed Consent Letter for Parents/Child Participation

Research Project Title: Building digital video games at school: A design-based study of teachers’ design of instruction and learning tasks to promote student intellectual engagement, deep learning and development of 21st century competencies

Investigator: Deborah Gail Lambert

Sponsor: NA

Research Approval: The University of Calgary Conjoint Faculties Research Ethics Board has approved this research study.

Dear Parent or Guardian:

Your child/children's teachers at your school will be involved in a research study related to the design and building of digital video games to assess its promotion of student intellectual engagement, deep learning of chosen humanities academic content and development of 21st century competencies. This consent form, a copy of which has been given to you, is only part of the process of informed consent needed to carry out this study. If you need more details concerning this research, feel free to ask. Please take the time to read this document carefully in order to understand any accompanying information.

Purpose of the Research

In light of the impact of emerging technologies on education, the purpose of this proposed research study will be to address one of the main concerns of teachers and administrators in many Canadian schools, that is, to find ways or instructional strategies to help their students learn the content of core academic subjects, while equipping them with 21st century competencies—new or innovative and different ways or instructional strategies that have the potential to challenge and intellectually engage them in deep, meaningful and authentic ways in the formal classroom context (Dunleavy & Milton, 2009). This will be done by using a design-based research approach to carry out a design experiment in a formal, public school classroom context to explore the potential of a chosen innovative intervention, the design and building of digital video games, as an instructional strategy—ensuring a focus on learning as opposed to teaching (C21 Canada, 2012) in an attempt to intellectually engage students in deep learning of content in core academic subjects and equip them with 21st century competencies.

Two primary research questions guide this research study: (1). In what ways do teachers’ design of instruction and learning tasks need to shift when designing and building digital video games to intellectually engage students in deep learning in formal classroom contexts? (2). In what ways does the design and building of digital video games in school impact students’ intellectual engagement, deep learning of core academic content, and the development of 21st century competencies?

What Will Your Child Be Asked To Do?

Your child will be involved in the design and building of digital video games as a project during their learning of chosen humanities content in class. The students will be guided to design and build their games with an absence of violent activities. With your consent, your child may be asked to:
• complete an online survey about their video game experience (The online survey is being administered by SurveyMonkey®, a web survey development cloud based (Software-as-a-Service) American company. As such, your responses are subject to U.S. laws, including the USA Patriot Act. The risks associated with participation are minimal, however, and similar to those associated with many e-mail programs, such as Hotmail© and social utilities spaces, such as Facebook© and MySpace©.
• provide the researcher with samples of their work, pictures of their work, audio-taped discussions, debates or conversations while they work on their games and video-taped samples of their processes in designing and building the games. Videotaping will only capture computer screens and students’ hands on their keyboards or as they point to the monitor to explain their designs. If artifacts of your child’s work samples are posted online, your child’s name will not be used. If your child is interviewed, he/she will be interviewed within groups of 6 for 30 minutes, supervised by the classroom teacher and interviewed by the researcher in a quiet location at the school, before, during, and at the end of the project. These interviews will be audio-taped to accurately quote some of the expressed views on their experiences and opinions of the project in terms of intellectually engaging then in deep learning of the given content as well as their development of 21st century competencies. In transcribing these interviews, your child’s name will not be used. Your child will only be identified by grade and a pseudonym.

Your child’s teacher may give permission for a researcher and/or a specially trained research assistant to enter the classroom to document the levels of intellectual engagement, deep learning of the chosen content and development of 21st century competencies using classroom observation protocols.

Dissemination of Findings
Findings of the study will be presented in a research dissertation, in partial fulfillment of the requirements for the degree of Doctor of Philosophy (PhD). Copies of the publications or other reports resulting from the research will be provided to the participating institution to inform future instructional strategies at the school. Findings will also be disseminated or reported in presentations, conferences, professional associations and peer reviewed publications. The school will be identified in the dissemination and reporting of findings. With parental and teachers’ permission, students’ artifacts will be published online for interaction with other game communities from other schools.

What Type of Personal Information Will Be Collected?
Should you approve for your child to participate, your child will be asked to provide his or her gender to let us know the number of females and males that are participating in the study.

<table>
<thead>
<tr>
<th>Gender</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
</table>

The data collected from your child could include:
• An online survey about their video game experience
• Audio-taped 30-minute individual and group interviews
• Video-taped and audio-taped sessions as your child discusses, debates or converses with his/her teams while they work on their games. An overview of your child’s detailed tasks during the intervention is attached.
• Pictures of artifacts of student work samples
• Artifacts of student work samples
• Observations in your child’s classroom by researcher and/or a trained research assistant using classroom observation protocols

Are there Risks or Benefits if I participate?
Though this research study will be connected to the learning of content in the humanities course, your child’s participation, non-participation or withdrawal from the research activities will have no effect on his/her academic standing or continuing relationship with his/her school.

Due to the nature of recruitment and data collection, your child’s involvement in this study will be widely recognized by his/her classroom teacher(s), other teachers, and students. There are several
options for you to consider if you decide to allow your child to participate in this research. You can choose all, some or none of them. Please put a check mark on the corresponding line(s) that outline your wishes for consent:

<table>
<thead>
<tr>
<th>We grant permission for our child to remain anonymous in written reports on the findings of this research study.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes: ______ No: ______</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>We grant permission for our child to be publicly identified by name in written reports on the findings of this research study.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes: ______ No: ______</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>We grant permission for you to use artifacts or work samples, pictures of work samples, transcribed discussions or conversations from our child.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Please note:</td>
</tr>
<tr>
<td>• Your child’s teacher will also be asked to grant the same permission and only those artifacts or work samples that have been approved by parents, the student and teacher will be used to present and analyze the findings of this study.</td>
</tr>
<tr>
<td>• Your child will still participate in all classroom activities even if you do not wish to provide the researcher with access to the work your child produces.</td>
</tr>
<tr>
<td>Yes: ______ No: ______</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>We grant permission for our child to be observed in the classroom (i.e., anonymous notes will be taken by the researcher using classroom observation protocols). Your child will still participate in all classroom activities even if you do not wish to provide the researcher with permission to observe your child in the classroom.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes: ______ No: ______</td>
</tr>
</tbody>
</table>

It is hoped that my presence, as a researcher, will not be too invasive to the teachers or the students. I will always provide advanced notice of my arrival and will always be available to answer any questions you may have.

**What Happens to the Information We Provide?**

Your child’s participation in this study is strictly voluntary. You or your child have/has the option to discontinue your child’s participation in the study at any time during the study. If you choose to discontinue his or her participation in the study, the data collected from your child, up to the point of your withdrawal, will be used in the analysis of the data, and no further data will be collected.

Should you decide that your child’s participation in the study remains anonymous, the information your child provides will be kept confidential. To keep the information your child provides confidential, your child will only be identified by grade and a given pseudonym, for example, student H. To ensure confidentiality of your child’s data, all copies of field materials including their written experiences or opinions, transcribed interviews, videos, pictures and artifacts containing identifying information will be stored in a locked draw to which only the researcher will have the key. All digital data will be encrypted and password allowing only the researcher to gain access to the data. All data will be held until August 2019 and will be
subsequently destroyed. Paper data will be shredded and electronic data will be deleted and the hard drive erased.

**Signatures – Written Consent**

Your signature on this form indicates that you 1) understand to your satisfaction the information provided to you about your child’s participation in this research project, and 2) agree to allow your child to participate as a research participant.

In no way does this waive your legal rights nor release the researcher or involved institution from their legal and professional responsibilities. You and your child are free to withdraw from this research project at any time. You should feel free to ask for clarification or for information throughout your child’s participation.

**Submitting this consent form**

After you have completed and signed this form, please seal it in the envelope provided, and drop it off in the box provided for this purpose in your child’s classroom. The researcher will collect it from there.

School Name:  ________________________________________

Participant’s (Child’s) Name: (please print) _____________________________________________

Parent/Guardian’s Signature: ____________________________ Date: ______________________

Researcher’s Name: (please print) ____Deborah Gail Lambert____

Researcher’s Signature: ________________________________ Date: _______________________

Research Supervisor’s Name: (please print) ____Dr. Michele Jacobsen____

**Questions/Concerns**

If you have any questions or want clarification regarding this research and/or your participation, please contact:

Deborah Gail Lambert

Dr. Michele Jacobsen, Doctoral supervisor

If you have any further questions or issues concerning this project that are not related to the specifics of the research, you may also contact the Research Services Office, University of Calgary at (403) 220-3782; email rburrows@ucalgary.ca

A copy of this consent form has been given to you to keep for your records and reference.

**Studies Involving Children:**
The researcher will, and if appropriate, explain to your child the research and his or her participation, and will seek his or her ongoing collaboration and assent throughout the project.
Appendix R

Child’s Assent Form

- Online surveys
- Audio-taped 30-minute individual and group interviews
- Video-taped and audio-taped sessions
- Pictures of artifacts of student work samples
- Artifacts of student work samples
- Blogs
- Classroom observations

Example verbal protocol to obtain children’s assent:

Read aloud by researcher, without the teacher present:

“I am Ms. Deborah Lambert, a doctoral student at the University of Calgary. I have been invited into your classroom until February or March to observe how you are learning about chosen topics in Social Studies while you will be designing and building digital video games on your laptops. Before I start observing the class, I hope to use an online survey to find out about your experiences with computer video games. This will help me to decide whether the class needs to learn and practice how to design and build mini video games before the class starts designing and building games to learn about chosen topics in Social Studies. I also hope to use another online survey to get more information on your learner profile so that we can place you into groups for the project.

Whilst you are designing and building your video games about chosen topics in Social Studies, I will be walking around the classroom, video-taping some of your group sessions as you discuss, debate and converse with each other. I will also take pictures of your games as you design and build them on your laptops. Sometimes, I will ask you about your games as you are designing and building them in class.

I will also be interviewing some of you on your opinions and experiences before, during, and at the end of the project. These interviews will take place in groups of 6 for about 30 minutes and will be audio-taped to make sure I can accurately quote some of your expressed views on your experiences and opinions of the project. I will not write down any students’ names, just ‘Grade 6, student Z’. 

I will also be following your blogs as you discuss and build your games and will use some of these conversations, videos and pictures to accurately quote and represent some of your expressed views on your experiences and opinions of the project.
Instructions and verbal protocol

1. Please take a look at the top-half of the paper sheet I have given you. Please write your first and last name on the form.  
Name _______________________

2. Before I begin with each question, you need to remember: It is okay if you do NOT want to take the survey, be interviewed and allow me to observe, ask you questions, video tape and take pictures of your designs, and audio tape your conversation as you are designing and building your digital video games about chosen topics in Social Studies on your laptop. Please do not check your form at all if you do not want me to collect study data from you. I will only collect data from students who have given their permission.

3. Researcher Prompts: Can you please make a check mark on your form:
   - Is it okay for Ms Deborah Lambert to carry out the online survey to find out about your experience with computer video games? ____ Yes
   - It is okay for Ms Deborah Lambert to carry out the online survey to find out about my learner profile. ____ Yes
   - Is it okay for Ms. Lambert to observe how you are learning about chosen topics in Social Studies and audio taping some of your discussions, debates and conversations with your group? ____ Yes
   - Is it okay for Ms. Lambert to video-tape and take pictures of your monitors while you will be designing and building digital video games on your laptop? ____ Yes
   - Is it okay for Ms. Lambert to ask you questions while you are designing and building digital video games about chosen topics in Social Studies on your laptop and audio tape your answers? ____ Yes
   - Is it okay for Ms. Lambert to interview you about your opinions and experiences during the project? ____ Yes
   - It is okay to follow and take samples of your blogs on the project.

Thank you very much.”

Artifacts of student work samples – child’s assent (the other half of the paper distributed in class by researcher, and read aloud by the researcher):

“You will be designing and building digital video games to learn about chosen topics in Social Studies. I am interested in studying how and what you are learning while you are designing and building your video games to learn about chosen topics in Social Studies. I am, therefore, asking for your permission to make a copy of your completed games. You will keep your original games. Please write your name in the space below and use a check mark to let me know if I can make and keep a copy of your game.”

You can make and keep a copy of my completed digital video game:

YES ____   NO____
See below for the handout for students.

**Student Assent Form**

Name _______________________

I want the researcher to collect data from me.  ____ YES  ____ NO

**Some data collection is okay**

It is okay for Ms Deborah Lambert to carry out the online survey to find out about my experience with computer video games.  ____ Yes

It is okay for Ms Deborah Lambert to carry out the online survey to find out about my learner profile.  ____ Yes

It is okay for Ms Deborah Lambert to observe how I am learning about chosen topics in Social Studies and audio taping some of my discussions, debates and conversations with my group.  ____ Yes

It is okay for Ms Deborah Lambert to video-tape and take pictures of my laptop monitor while I am designing and building digital video games.  ____ Yes

It is okay for Ms Deborah Lambert to ask me questions while I am designing and building digital video games about chosen topics in Social Studies on my laptop and audio tape my answers.  ____ Yes

It is okay for Ms Deborah Lambert to interview me about my opinions and experiences during the project.  ____ Yes

It is okay to follow and take samples of my blogs on the project.  ____ Yes

You can make and keep a copy of my completed digital video game:

YES ____  NO____
Appendix S

Elevator Pitches

Links to Videos:

https://www.youtube.com/watch?v=nTObAn5A2X8&feature=youtu.be
https://www.youtube.com/watch?v=haK1G2oykOk&feature=youtu.be
https://www.youtube.com/watch?v=TGIJwzbGeqA&feature=youtu.be
https://www.youtube.com/watch?v=2-Go_tsNxB4&feature=youtu.be
https://www.youtube.com/watch?v=jSMznfsnEg&feature=youtu.be
https://www.youtube.com/watch?v=mRzHcfncEzQ&feature=youtu.be
https://www.youtube.com/watch?v=2OJ_kvjt9E&feature=youtu.be
https://www.youtube.com/watch?v=OhNDNjxJu3Q&feature=youtu.be
https://www.youtube.com/watch?v=9iCuqwLPDk&feature=youtu.be
https://www.youtube.com/watch?v=gkcTMKt7xtM&feature=youtu.be
Appendix T

Examples of Students’ Responses to Summative Assessment Across Classes
(quoted directly from Kidblogs, June 2014)

Group 6.1

Boy EB: I thought this would be very fun when I first received this assignment. Later on in the project I realized that I wasn’t comfortable in my job. Then I realized that because I wasn’t very good I didn’t enjoy it very much. I have gotten a little better at the job since the beginning of the assignment. One challenge I overcame was I couldn’t figure out how to make it jump. Our final project shows that I am an ok programmer because I rushed through parts and those parts aren’t very good. I am most proud of the scenes where you jump because I had to figure out how to make it jump and it was very tricky. If I could go back and do it again I would not be the programmer and try something new I would also let someone who is more comfortable in the job do it. I think if I did it again I would be the musician because I am musical. I think that I did an ok job. I think I would’ve done a better job if I was more comfortable in the job. I think I produced some good work and some bad work. I wish I would’ve practiced more to get better at my job.

Girl YL: Why does it have to end. We just got to the easy part of programming our game and now we have to come to an end. We don’t have much completed but so far my favourite part is when you start to play the game instead of the introduction. The reason why that is my favourite part is it was one N and I’s biggest problem and we just completed and it worked out perfectly.

During the game my role as the leader rarely changed. The only thing that changed about my role was who I was helping. Most of the time I needed to help N (the programmer) out and the artist. One of the biggest challenges that we could not get the music that F made into scratch because it needed to be a WAV or mp3 file. Finally our group found an app and converted it to a mp3 but it still didn’t work and we ended using a WAV file.

Some things that didn’t exactly work in this project was scratch. It actually deleted half of our work and now we have to reduce it. Some good things about scratch so that we have the opportunity to try different things and to have fun doing it.

This project was very fun and interesting. When we heard about this project I thought it was impossible to make a good interesting game about decision making. Then we got started on the project and with the amazing group I had we got right to work and it was very fun. The only thing that is unfortunate is the amount of time we ended up having to do this project. Overall this was probably one of the best projects I have ever done and I am looking forward to seeing what is coming in grade 7.
Boy AB: I feel that I have been effective at my role because I worked on the dialog pretty hard but finished it with time left over. So I decided to help work on art I got a few slides done before helping with programming. When I first got my role I thought dang I’m not great at writing story’s because in the past I have had troubles. Although I decided to suck it up and do it and it turned out okay. My understanding of the role changed when we did our story board because I thought hey I’m the story writer. Then I realized that I did dialog for the game. I do not know how our game reflects my work when it has no dialogue in it yet. I felt that this project was a unique experience for me because it was a brand new type of experience for me with little experience in video game designing.

When I first got my group I was glad that we had A as our leader because I felt that it would help me and others to not get off task as much. I feel that I could have worked on the programming instead of the art because my group needed me more in the library programming because I was able to program and our programmer was not as experienced as me. I also felt that I could have done more after the art was done like how I did not go up to the library because I would not answer FaceTime since face time was not allowed. But if I where to go back in time I would have thought maybe I should go up stairs because they might want something. They did to they wanted my help so I feel responsible for not much programming being done. I also feel that this project was a fun new experience but if we did it again I would want to have a different job for a different experience in this project. Bit overall it was a great time and a new experience that was a lot of fun.my group I felt goofed off quite a lot though but still got enough work done.

Girl KN: This project was so much fun. I really liked the idea of creating a game instead of a keynote or pages document. I found this project different then the projects we have done in the past because it was more student-led compared to the teacher telling us exactly what we have to do. I found this project very challenging, fun and creative at the same time. The biggest challenge for our group was working in Scratch because we have never used the Scratch program before. To overcome most challenges in Scratch we would just find a tutorial on Google and usually we would find the answer to the question we had. Our game is not completed yet, so far we have only got just past the introduction. But now programming won’t be as hard because we our more experienced in scratch and all the basic controls are set already. Even though our group works really hard in class and we work together well, it still seems like we won’t have enough time to complete our game. But I’m sure if we all work a little but at home our game will be completed by the end of this year.

Since I am the programmer for my group I felt that I had a lot of pressure on me to create the game we planned in our story board. I knew if I was the programmer I would have a lot of work to get done in class and probably have to work a bit at home. I think I did a good job programming, I took my role seriously and every class tried to get as much done as possible. We are not very close to finishing our game but my favourite part about the game is the part
when you actually get the play the game. I like this part because it was the hardest thing to make and it turned out really well.

When we first got this project I did not think we would actually be able to create a video game in grade 6. So I am very proud in what our game turned out to be. During this project our whole group stepped up and accomplished their role. I learned so much during this project not just about Scratch, but I really deepened my understanding about how Iroquois’s decision making process worked. Overall I am really proud of our final product and hope we can do another project like this in the future.

Boy LG: I felt nervous when we were first given the assignment because I have had no experience in creating games so this project was a big learning experience for me, I felt like a sailor sailing in to uncharted waters, and probably the entire class felt the same as I did. I also felt a little exited to start something new like this. My first idea of my role as story writer was to write everything that is going to be in the game and apparently I thought right. This role was challenging at parts and easy at others. The easiest part of the role was writing the dialogue because once we got are idea the dialogue just popped in theirs. The most challenging part of my role was figuring out what to do after I did my job. I moved past this by looking at are project and asking myself what could be better, it turns out are artist needed more hands on creating art. The thing I am most proud of in my group game is the programming because the project looked good with the fluent motions of are characters. If I could go back and do this game again, I would think of a better idea because are game is basically a quiz game and because I was not able to attend school when my group chose the time period. Over all I think I was very effective in my role for scratch in creating the path that my group followed.

Boy OD: I do feel that I accomplished and completed my job. The reason I feel this way is because I feel I got appropriate and engaging music because I received clarification from all my fellow group members. After completing my job I then helped will with the artistry when all photos from our storyboard were finished I then went to the library and helped T with the programming. At the time I didn’t know much about programming but quickly learned thanks to T. The first time I went up to the library was to help T import the photos that M and the rest of our group had made to scratch. Reason be I was the only one in the group that knew how to import photos onto scratch as a file that would work to program with.

My understanding of my role in scratch developed to be much more clear over time and I began to understand more and more what my part in this project was. At the beginning of this project I thought that the only thing I had to do was music and I was done. But I very quickly learned through class discussions and discussions with my group that I’m not only meant to do my job but help out with other peoples jobs. And that everyone assigned to a job is just the leader of that specific job and then if someone asked to help you would offer what they
can help with. And the leader is just the chaperone the one that guides everything and keeps everyone on task to their greatest will.

When I first received my assignment I was a bit anxious at first then slowly began to enjoy the project and actually have fun working on it. I think I had great luck with my group itself because we all get along very well. We argued a few times but not many and it was mainly just a disagreement which then solved itself.

During our work we all had a few challenges and we all mostly overcame them my challenge was how to import the music into scratch and still don’t fully understand how. So speaking for my self I somewhat overcame my challenge but yet feel as if I hadn’t.

**Group 6.2**

**Boy FM:** Our group is for the most part, done our Scratch game. All the slides except one have been completed, as well as the characters. The music has been out in our game. W is just adding the last slide to the game on the weekend, and it will be pretty much done. This was a great project, with some bumps along the way, but in the end it all worked out.

Overall: Our class and my group has almost finished our scratch game building process! However, there are still some things to do. W, our programmer, has been touching up the slides. We have finished all the backdrops for the game, as well as all the characters. The music will be or already is in the game. H, our leader, has been checking around, and helping me with the final slides to our game. We have posted all of our slides and storyboard on the chat. There has been a little argument here and there, but overall, we have been pretty productive.

When I first received my assignment as Artist for my group, I became sort of nervous, but very excited to show my interest in art. I wondered how I would integrate my ‘skills’ into a modern, city politic- like game. I immediately began talking with my new group members to come up with the ‘meat’ of our first game, which was a zoo like theme. I collaborated with A and began to design the zoo scene. I kept on this path, and while at first I was only doing art, by the beginning of the ‘actual’ project I was helping all my group members in their various roles.

Through this project, my understanding and my way of perceiving the role of artist changed somewhat, but not drastically. At the beginning, my impression was that the artist was the one who would design ALL the characters, and the scenes. I thought I would have to create something WAY more sophisticated than our final project (something like a moving background). I also thought that I would be designing a game on PAPER, not on a digital platform such as an
iPad. Through the project, I began to grasp that as an artist, you have the whole groups ‘look’ of the game in your hands. But I also found that you don’t have to just do Artist, you can also help other people (musician, programmer, writer).

A challenge I overcame was getting all of my work to the programmer, and furthermore, getting them to put it in their game. This wasn’t the biggest challenge I faced, and it happened early on in the project. I got over this by my own knowledge of scratch, and by putting it into an image form and making and iMessage chat, and putting it on the chat so the programmer could see it, save it and put it in our game.

The final product shows the effort that I put into designing the slides, and even some of the storyboard characters. It shows the player how good the artwork was and how good I was in making it.

I am most proud of my work in making the slides, but also in helping make the story. I am proud, not only of my work as an artist, but of all my group members and the roles they did to make an AWESOME game.

**Girl PR:** When I was assigned to be the writer in the group I was not overjoyed but I wasn’t ether sad because I do like writing but not too much. After we got completely sucked into scratch I learned I didn’t just have to right but also kind of work with the artist so we can decide how each scene would end up. In this project I wasn’t the only one thinking of the concept our whole group was in this together. I think the progress we made so far I think that is credited to everyone because I think everyone had a important role in this project. The role I had was (from my personal view) just a part of the puzzle. I still think I had some obstacles along the way because when I had to right what was going to happen in the scene I was a bit confused of how put that in one sentence or so but my group helped me when it came to describing the scenes. Another thing was that the whole group had to really carefully decide of what will happen in the scenes because the programmer wasn’t a expert but what ever the programmer can do or what he learned we had to keep that in our mind, but the programmer I think was pretty much of a expert because the programmer had the time to go look up videos. Overall I think that I did a pretty good job as the writer.

**Boy BL:** We all contributed a lot but there were “some” obstacles this unique group of individuals came together know nothing about how to make a game and left knowing a lot about making games. But honestly there were times were certain people did nothing at all people sat and did nothing some played games some left and weren’t seen till the end of class but once we started to work together everyone worked great together we were all on task we all did our jobs and once they were all done we helped others out - when i first received the project i felt pumped i was so exited to make a video game but when our group came together and got down to business it was way more complicated them just making simple game.
- my understanding of the role has changed completely for instance I’m the musician so i just thought I was making music to go with the game. But now i know that the emotion in the game depends on me i help create what the gamers feel.

- the biggest challenge was people distracting me there where people who were like “oh come do this oh come do that” and all i said was i need to get this done first and as hard as it was i did it.

- our final product shows that some people put in enough effort to get through and some put in so much effort they would easily get through but all in all our final project is awesome and every one contributed to their role.

Girl DB: I am really loving my group and I think we are doing very well and all of the rolls that we got suit our selves. M’s drawings are the best so far she has made great progress and it’s a good thing that she changed to artist. R has a cool story board down and J has been a great leader and she is keeping the group on track. P has been having trouble importing her beautiful music hopefully that part of it gets better on the computer.

My role was very hard to complete there where some ups and downs in the process. When I received this assignment at the beginning of the year I did not think I could do any of this. The biggest challenge was when I felt left out of the group and we where not communicating very well. At that moment we did not think it could get worse but yet it did. The music was not going in, P had a lot of weight on her shoulders and she started to get stressed. Me and R decided to step in and give P a break. After we got everything settled we where back on track. My understanding of the role has changed one day it was getting the music done and the writing done the next day it was getting programming done. We use to have a system that I did not personally agree on, it was that when it is your turn to go up the programmer comes down. That did not work so well. The final product will effect me a lot because when I get older I would like to be a teacher by the time I’m old enough to teach all of the schools will probably iPads or laptops and I will want to do this project. I am most proud of our group and how we worked together and got through tuff challenges, but it was not all fun and games.

Group 6.3

Girl LR: I think that I have been pretty effective in my role or the story writer because our group thinks that our game concept and dialog are coming along really well. When I received the role of the story writer, I thought it would be a role that fitted me quite well and that I would excel the expectations needed for this job. It wasn’t as easy as I thought. Writing the story board out with the rest of my group together was nice, although it was hard to figure out all the dialog that went along with it. At the start of our project, I thought that the title of
“story writer” in this case meant that they do the story board and figure out how the game is going to run. I found out that the story writer actually means that they write the dialog, they might give the programmer ideas about how we could slightly change parts of the game, but once the story board is finished, most of the game is set in place.

One challenge that we had was the story board getting lost. Thank goodness we had taken a photo of it on my iPad before we lost it. We solved this problem by looking at the story board from the iPad and roughly figure out what happened so N could keep the programming going.

I am most proud of the way we designed the game with the letter and the missions. I think this is a great way to bring the character around Ancient Athens, and still have them learn along the way. The ending is one of my favourite parts of our game, because it shows how people can get ostracized and it’s kind of funny with him walking into the sunset. I think that this scratch unit for humanities has been interesting, although it has some challenges. It was overall very fun and I think I’d like do it again if we had the chance.

Girl PH: At first, I wasn’t very excited to be leader. Honestly I thought it would be hard/stressful because I didn’t know what to do at first and it was hard at first. (I have the hang of it now, hopefully). My understanding actually kept on changing, as a surprising about of challenges raised as time went on. But yeah, it is a easy/hard role, it changes. But it definitely isn’t as hard or stressful as I thought it might be.

A difficult challenge that came from my group that related to my role was how at first, people didn’t agree with each other and it was hard to resolve it, but we did. (I didn’t know how it related to my role but it did, because I had to help solve it and stuff). If I could re-do the project and do something different with my role, I’d say to help with the music more, or help with the literal programming more. Like, I did help with the programming but I think we could have done stuff differently and more productively if I helped out more. And I didn’t actually help with the music that much, I helped decide what to use and what to change, but I’d work on the music more. Out of 4, my productivity level is between a 2 and a 3. 2.5? Our group over was semi-successful and I’m proud with the art the artist made and the music that L made.

Boy MW: I think that I did a good job at being artist through this project. I did all the tasks that I was asked to do and all in time. But I also think that I could have done better work on a couple of the drawings but over all I think I accomplished my job as artist. It was difficult to work with my group but as I’ve said in other posts we eventually started to work well together. This was a problem for because it was distracting with all the argument between the group members. The thing I am most proud of is the cave scenes in the game I think this because
of how well the transition from one bio to the next is and because of how much detail I put into it. I also think that it reflects my skill (a bit.)

**Boy VR:** How has your understanding of the role changed over time?
My understanding in the beginning was that you have to create music on any instrument and record it but now I know that different instrument makes certain sounds and you have to make it so it matches the theme.

- What was one area of challenge relating to your role that you overcame?
The area of challenge in my role was actually making the music because sometimes it’s hard to think about what beat you have to use and what you need to record.

How did you move past this challenge?
How I moved past my challenge was at home I have a piano so during my piano time i think of beats to play and when I’m done I go onto my ipad and try to play the beat.

- How does your final product reflect your skill and expertise regarding your role?
My final product was good but I don’t think that I’m a expertise regarding my role as a musician.

- What are you most proud of in your final game?
What I am most proud of is the work and the music that I have created because scratch really motivated me to create Athens music or like jazzy music.

- If you could go back and do it all again, what would you do differently in your role?
What I would do differently is maybe I would spend more time on the thought of my music. I think I have worked effectively on my music role in scratch but I could have always done better.

**Girl NE:** I think I have been pretty effective in my scratch group but I didn’t finish all the required things I had to draw. I think I was effective because I worked really hard in class time, and also got feedback from my group. I think I was a little bit insufficient at times because when I came to class and my group asked “did you work on your scratch at home?” And I reply “no” they are very surprised.

A very big challenge in being the artist is that almost the entire game depends on you. If you don’t get they characters and the other things drawn and finished, the programmer can’t program, and the game won’t move on.

Unfortunately, I didn’t completely move past this challenge, but luckily Rachel agreed to help me. (Big thank you to D) Even though D helped me I was still not able to complete my task as the artist. If I could go back and redo my job, I would ask my programmer what I need to draw, and when I need to be finished. Although that is what I wanted to do, I think that is also a little bit the
programmers fault because She didn’t tell me what I needed to do, but I never really asked.

Boy LL: When we first got this project I thought we were going to nail it, then be bored for the rest of the classes. It turned out to be far more challenging than I thought it would be.

First we had to research some questions about Ancient Athens, then come up with a game idea. It took us quite a while to get the go-ahead from [name of teacher], because we misplaced our story board multiple times. Once we were ready to start, our classes were half gone!

My understanding of my role change throughout the project from kind-of a supporting group member, to one of relatively high importance.

One area of challenge that we faced was when we kept misplacing the story board and could not pass the pitch part of the project. The way we got through this was every time he gave us feedback, we went back and changed our plot, until we passed.

The thing that I am most proud of is the starting theme, which sound very, good and much like Pirates of the Caribbean.

Group 6.4

Boy CV: I think as a group member I did a pretty good job playing my role as story writer. In my role my goal at the start of this unit was to do a good job of creating a story line and a story board that my group members could understand. I think that I did a good job completing that goal. I think that I did because my group members could understand the story and asked me questions and I answered them pretty well. When I first got my assignment of story writer I felt like I fit the job. When I got my role the first thing I did was to create the storylines for our mini games. My understanding of my role got more challenging as I went on. It got more challenging because I was creating better storylines and eventually, create a story board.

One challenge that I faced was the big part of the story board, which is the music, sound, FXs and motion. I overcame this challenge by asking the group leader and checking with everyone else in my group, to make sure that the changes that I made was ok with everyone. I think that my role had to be in or else the programmer would have nothing to program! The project right now is pretty good it does follow the storyboard. That was my goal to make sure everyone understood what the story was. That was my goal so I think that I did good. In our game the player has to find scrolls for information to unlock doors. I made most of the scrolls so I am most proud of that. In my role I think that I
I did a good job and I like the way it is so I would not change the way I did my job as story writer.

**Girl KS:** I think I did a good job of writing the story board and creating our ideas for the game. I took our game idea and elaborated on it a lot. When I first got this I liked my job and stuck with it. I thought this would be impossible and we would never get it done but now I know now that we may be able to finish most of it. At first I thought I would only do writing stories but after that I had nothing to do so I started helping other people with their jobs.

When doing the story board it wasn’t going as fast as I wanted it to so I thought of ideas faster and wrote them down and handed them to the artist to draw and that improved our speed. We still aren’t done our project but so far it’s reflecting well on my job because it’s following our story board except some minor tweaks.

I’m most proud of the story that is behind it and the main reason why he is going on this adventure. If he didn’t have that story then there wouldn’t be any point in the game. I would change of how it started by doing nothing and just sitting around. Also I would maybe not give up as easily.

**Girl ZY:** I felt at the beginning kind of like “how are we going to do this in this amount of time?” I felt that because we only had a few months to create a full game explaining our understanding of our subject. I kind of was like this :/

How has your understanding of the role changed over time?

I think at the beginning i thought i was just going to find pictures and give them to G but I was totally wrong. I now am drawing most of our backgrounds and characters (It is kind of insane).

Some of the challenges were, G would say something that I needed to draw then I would draw it then give it to him, but sometimes he said “Oh, no not that I wanted This.” and that was a huge problem but all we needed more explanation and we were good. Also sometimes I could not draw what he could ask and we needed to go around that on object.

This final project shows my ability of making art because I was making characters and backgrounds off the wahoo and most of the project is my art so all of the people who see it will see my art.

I am most proud of that we made a game because scratch is not that easy to use for making games. Also I am proud of the time just because teachers could say “yup, you have to make this in a week. See you then!” But they didn’t and that was helpful.
If I could go back and do it all again I would... I don’t really know actually. Maybe there are somethings that could go better on my behalf but I really don’t know.

Boy HY:  - How did you feel when you first received your assignment? Why?
I felt like it was going to be very hard, and I was right. Why I thought it would be hard was because I don’t have any experience with mac computers this year, therefore not being able to export music files to an apple computer.

- How has your understanding of the role changed over time?
At first, I thought it was just make music then roll with it. But now, I find it to be very artistic and have to work hard. The art comes in when you have to make a specific music piece and use different music to portray what is happening. The working hard part is when you don’t understand what they mean by this music, and you try to understand.

- What was one area of challenge relating to your role that you overcame? How did you move past this challenge?
Finding out what doom music meant. At first I tried searching it up, I just got the video game DOOM. How I overcame this is using a thesaurus. From that, I knew that doom meant fear, so I created music of fear!

- How does your final product reflect your skill and expertise regarding your role?
Our final product, just isn’t finished. Technical problems back me off from this, therefore, no music. But the good thing is, drop box is there.

- What are you most proud of in your final game?
I would say my Western music. Even though it never made it into the game, (because of technical problems) I still enjoyed making it and group members liked it too. For the whole thing overall, I would say the background art is good because of the detail!

- If you could go back and do it all again, what would you do differently in your role?
I would find a way to export music files from the iPad to the computer earlier in the year, and know more on my music smarts. The reason why I would do this is because then I can get more work done! EDIT: Scratch is the problem here.