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INTRODUCTION TO DESIGNING RESPONSIVE PEDAGOGY

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IDEAS 2015, Designing Responsive Pedagogy, is the third annual teaching, learning and research conference co-hosted by the Galileo Educational Network and the Werklund School of Education at the University of Calgary. The conference mandate is to share the scholarship of innovative teaching practices that is occurring in today's classrooms.

The IDEAS conference is about community engagement. It provides a rich forum for educators and educational leaders from K-12, higher education and government to come together to share in research and practice that is informing and setting the direction for contemporary education. Through the conference and with the proceedings, educators are demonstrating how they are critically reflecting on theory and practice to improve teaching, learning, assessment and research in today's K-20 educational contexts.

DESIGNING RESPONSIVE PEDAGOGY

Lock and Friesen (2015) argued that "[e]ducators need to embrace work as designers or architects of learning within a learning society" (p. 99). To be a designer requires educators to be informed, to be creative, and to be able to be responsive to the challenge of creating inclusive learning environments to meet the learning needs of all students. It is about creating robust and meaningful learning. It is the ability to create learning environments where students have multiple means of engagement to be motivated, challenged and excited (Meyer, Rose & Gordon, 2014). Further, the College of Alberta School Superintendents' Twelfth Dimension Framework (2010) supports the notion that teachers need to be designers of contemporary learning. This requires the following:

1) Development of strong authentic discipline-based inquiry;

2) Scaffolding of student work and assessment practices that assist each student in improving, growing and thriving;

3) Use of networked digital technologies to create knowledge-building classrooms;

4) Strong relationships with students, other teachers and experts in the field for the purpose of learning together; and

5) Work with peers to critically reflect on practice for the purpose of improving practice.

As designers of learning, teachers need to be able to design responsive pedagogy. Often the question is asked, what does it look like in practice? How can design thinking be implemented in elementary school learning environments in contrast to what can occur in senior high school or in a graduate seminar? The goal of this peer-reviewed conference proceeding is to showcase how educators are designing responsive pedagogy that is embracing leading edge teaching and learning practice in K-20 learning environments. In the papers, educators and researchers are sharing contemporary instructional practices, data from their research into their innovative practices, and reflections that illuminate factors, attributes and insights to the importance of responsive pedagogy in a knowledge society.

The proceeding is composed of 21 papers that have been clustered into the following four sections: 1) Design thinking; 2) Higher education; 3) Language and literacy; and 4) STEM education. Over 50 authors have made teaching practice public through the papers shared in this conference proceedings.

SECTION ONE: DESIGN THINKING

The design thinking section showcases five papers set within K-12 and higher education contexts. First, Parchoma and Power report on their ethnographic research where they studied the design and

teaching practices identified in graduate seminars. From their work, they created a design typology, based on the characteristics they found, for graduate seminars. Second, Quinn investigated the creation of a professional learning model to support creativity in learning and teaching. An examination of the literature informed the design of a learning series for teachers for which she studied the series to see how they engaged in the tasks and the processes. Third, Kelly and Barrette-Ng investigated how the Flipped Learner-Centred Interactive Classroom Strategies can be used to help instructors design a flipped learning environment. In their paper, they have provided a series of questions and answers related to this design work. Fourth, Lambert and Jacobsen shared findings from a design-based research study that examined the innovative practice of game design. Their research investigated how an intervention, video game design and building process, was implemented in Grade 6 Social Studies. Fifth, Koh and colleagues reported on their ongoing project focused on fostering in one school Grade 6 teacher capacity in using authentic assessment and assessment for learning. They shared from their preliminary findings that the use of robust professional conversations focused on specific assessment items, has resulted in teachers developing deeper insights into assessment. These five papers provide insights into strategies and techniques being used to support design-thinking initiatives.

SECTION TWO: HIGHER EDUCATION

In this section, seven papers are shared that highlight some of the innovative practices occurring in teaching and learning in higher education. First, da Rosa dos Santos and colleagues described how they used a book club approach in developing common understandings as a means for preparing researchers for practice. From their lived experience, they acknowledged how a book club provided a forum to discuss key ideas and establish new collective understandings which then informed their practices as designers and researchers. Second, Dyjur and Li explained how an

infographic learning task was used in a graduate level course designed to enhance 21st century learning skills. They shared from both an instructor and a student's perspectives how the assignment provided an opportunity for students to develop skills such as critical thinking, creativity and visual literacy. Third, Clancy and colleagues shared findings from a mixed methods research design focused on co-teaching in a nursing course. They investigated the complexity of the co-teaching experience and how that influenced leadership development and its relationship to nursing student professional practice. Fourth, Yu and colleagues described how micro-credentialing through the use of digital badges has being used to support faculty professional development. In their paper, they explained how they have established digital badges in a university setting and outlined a pilot study being conducted to examine the impact of the digital badges in support of educational development. Fifth, Kim, Gupta and Clyde outlined the iterations of designing and implementing digital game-based learning within a graduate course. Through the iterations of their work, they have designed the assessments in the course to also be game-like. Sixth, Brown and colleagues acknowledged that their experience using action research provided an approach for informing course improvement and fostering a responsive pedagogy in teaching graduate courses within multiple sections. They reported how the responsive pedagogy emerged through their reflections and collaborations as part of this action research initiative. Seventh, within the Caribbean context for library sciences, Nelson shared a number of design considerations to support cultural inclusion. She advocates that cultural inclusion needs to be addressed both in the design and the instruction in online library sciences courses. From these seven innovative practices, the authors illuminated key factors that influence responsive pedagogy in higher educational settings.

SECTION THREE: LANGUAGE AND LITERACY

This section consists of five papers that explored designing responsive pedagogy in relation to language and literacy. First, Scott described the positive response of individuals with autism spectrum disorder to music. To help teachers to engage students with this disorder, she proposed seven music-based activities that provide an opportunity for students to demonstrate their abilities with pitch. Second, Bartel Nickel shared her mixed methods research that investigated Grade 9 student achievement when comparing direction instruction and two collaborative learning models. From the data, she found that students perceived their learning to be enhanced through the use of collaboration and reported that their preference was for a computer supported collaborative learning model. Third, from their case study, Adamson and Fernandes shared best practices in arts education to support inquiry-based learning in schools through partnerships with the professional arts. From the example shared, they have provided a model to support such partnerships. Fourth, Amery and Koh conducted a review and analysis of literature that examined how face-to-face interactions and the use of blogs can foster intercultural competence in study abroad programs. In the conclusion of their work, they advocate that instructors need to have adequate and appropriate training and support so they can design and facilitate the development of intercultural competence in such programs. Fifth, Sabbaghan applied variation theory to teaching vocabulary in the context of teaching English as an additional language and exemplified lessons that can address patterns of variation in students' (mis)understandings. The authors of the five papers have demonstrated how various strategies, partnerships, and use of digital technology are enriching learning experiences for all students.

SECTION FOUR: STEM EDUCATION

The final section presents four papers that provide insights on responsive pedagogy within STEM education. First, Bhola and Parchoma conducted a literature review on chemistry education and examined how constructivist learning theories are applied in teaching and learning. From their review, they identified learning barriers and articulated the need for chemistry instructors to bridge discipline knowledge and "praxiological" knowledge to support student learning. Second, Metz and colleagues shared key principles that have emerged from the Math Minds project focused on enhancing early numeracy. In this paper, they reported that when teachers give greater attention to student responses and then make the necessary adjustments, this impacts student success, as well as allows for all to be challenged so to foster mathematical understandings and mathematical fluency. Third, Preciado Babb and colleagues, who are part of the Math Minds partnership, described the transformative learning experience of one teacher over a year. The aim of the Math Minds initiative is to change the way elementary teachers teach mathematics, which in turn improves students' learning of mathematics. Fourth, Sabbaghan and colleagues presented data showing how teachers experienced with the Math Minds initiative are using micro-level scaffolding to support student learning of mathematics. From the data, the authors identified implications for practice. From the four papers, it is evident that there is a shift in practice and teachers are exploring and adopting specific strategies and techniques to enhance the quality of learning and teaching in STEM learning environments.

CONCLUSION

The 21 papers provide examples of how educators are being responsive to learning needs in contemporary K-20 educational settings. The examples from the papers demonstrate various ways

that educators are engaged in being designers of learning. The papers showcase how educators are being intentional and thoughtful in their responsive pedagogical practices so to create robust learning environments to meet the learning needs of all learners.

Educators are drawing on literature and research to inform their practice. As well as, they are engaged in studying their practice to inform next steps. Further, through presenting at the IDEAS 2015 conference and now publishing their work in the peer-reviewed proceedings, these educators are making their work public so that others may learn *with* and *from* them. In addition, they are actively engaged in completing the loop of theory informing practice and their practice now informing theory in relation to teaching, learning, and assessment.

REFERENCES

College of Alberta School Superintendents. (2010). *The twelfth dimension of the CASS framework for school systems success: Systems leadership for learning technology success.* Retrieved from http://o.b5z.net/i/u/10063916/h/Communications/CASS_Framework_-_Dimension_12.pdf

Lock, J.V. & Friesen, S. (2015). 21st Century learning and diversity. In J. Andrews & J. Luppart (Eds.), *Diversity in education: Understanding and addressing student diversity* (pp. 74-102). Toronto, ON: Nelson Education Ltd.

Meyer, A., Rose, D.H., & Gordon, D. (2014). *Universal design for learning: Theory and practice.* Wakefield MA: CAST.

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DECONSTRUCTING THE GRADUATE SEMINAR: CREATING A DESIGN TYPOLOGY

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Talent development through innovative graduate education is a primary focus of national and international governments and their university funding agencies, and a contested construct. This ethnographic study examines current Canadian English- and French-language graduate seminar design and teaching practices in faculties of education. A series of interconnected discernible characteristics of graduate seminar design and teaching practices are illustrated on a Cartesian plane, where the (x) axis provides a continuum from professor-led to student-led activities and the (y) axis provides a continuum from knowledge advancement to knowledge application. Implications for talent development through innovative graduate education are discussed.

Keywords: Graduate seminar; Design; Teaching practices; Knowledge advancement; Knowledge application

CONTEXT

Talent development and creation of robust cultures of innovation in institutes of higher education are key foci in the Social Sciences and Humanities Research Council's 2013 - 2016 priority plan (SSHRC, 2013). For more than a decade, talent development through graduate education has been a social and economic priority across Canadian and international contexts (Costes & Stalter, 2010; Nahal, 2007). A 2003 European Union (EU) ministerial *communíqué* directed EU countries to

"increase the role and relevance of research into technological, social and cultural evolution and to the needs of society" through increased provision of high quality graduate education (Hopbach, 2010, p. 6). The Council of Graduate Schools work undertaken by 27 Canadian, Australian, Chinese, European, and American representatives resulted in the nine *Banff Principles* for improving the quality of graduate education globally (Nahal, 2007). In 2010 the *Commission on the Future of Graduate Education in the United States* declared that "we must invest in educating more of our population at the graduate level to ensure our capacity to innovate and to secure our intellectual leadership into the future" (Council of Graduate Schools and Educational Testing Service, 2010, p. iii). As universities across the globe increase their provision of graduate programs, pressure to attract, recruit, fund, and successfully support talent development intensifies; therefore, we need to know more about our graduate teaching practices.

The graduate seminar, despite being a perennial teaching practice implemented on virtually every Canadian campus, has not been sufficiently examined. Even the purpose of graduate education is marked by tensions between knowledge advancement and knowledge application (Auten, 2012; Levkoe, Brail, & Daniere, 2014). Contradictory indicators abound in defining just what graduate seminar teaching is or ought to be.

LITERATURE REVIEW

Our search of relevant literature returned a range of books, articles, and dissertations, almost all of which were researcher-practitioner accounts of studying outcomes of particular interventions in their own teaching practices within a single seminar. In French-language literature we found a single, non-peer reviewed book that included a clear definition of a graduate seminar. Tournier (1981) defined a graduate seminar as being made up of five to fifteen students, their professor, and

possibly an external expert, who collectively explore a given topic. She described the seminar as beginning with a presentation from a recent research project or a synthesis of current research. The purpose of the presentation is to spark a moderated discussion in order to critique received knowledge and advance thought.

Our English-language literature sample returned a single, peer-reviewed typology of graduate activities, and a comparable non-peer reviewed typology (Jaques, 2000). Steen, Bader, and Kurbin (1999) posited four types of graduate seminar activities: (1) professor-led lectures, (2) professor-led discussions, (3) student-led discussions, and (4) student-led read-and-present sessions, which they argue are often enacted in various combinations within any given seminar. Steen et al.'s article appeared in a special issue of *Teaching Sociology* with a series of response articles. Response papers identify inaccuracies (Eisenberg, 1999) and unsubstantiated assumptions (Maurer 1999; Schwartz & Tickamyer, 1999). Each of these critiques address the lack of evidence, or as Schwartz and Tickamyer frame the problem, as having developed a typology grounded no more firmly than on "impressionistic data based on [personal and professional] experiences' (1999, p. 181). These critiques can be held to a similar standard as these response papers also draw upon personal and professional reflections, which are retrospectively aligned with literature. While the typology is problematic, it provides an initial backdrop against which to examine alternatives.

A focus of design theory and practice is purposeful scaffolding of learning activities for knowledge construction, application, and advancement (Parchoma, 2004; Power, & St. Jacques, 2015). It has been argued that the complexity applying design theory to graduate teaching practice can lead to defaulting to "'commonsense' rather than theoretically informed designs" (Conole, Dyke, Oliver,

& Seale, 2004, pp. 17-18). However, there is a dearth of supporting evidence for this claim (Eisenberg, 1999; O'Donnell, Tobbell, Lawtham, & Zammit, 2009).

THEORETICAL APPROACH

Diversity in perceptions of purposes served in teaching and learning contexts reflect "fundamental differences in assumptions about the nature of knowledge, knowing, and knowers, and consequently about what matters" (Wenger, 1998, p. 4). Gumport (1990) posits that value attributions of graduate students' knowledge are made in relation to the enterprise(s) a body of knowledge serves. Graduate students' engagement in practices that serve particular knowledge enterprises can be valued differently by internal (student, professor, university administrator) and external (society, government, industry) stakeholders (Krause, 2012; Vidovich, 2001). As meaning and significance ascribed to graduate seminars are socially constructed, we situate our inquiry in sociocultural theory. Sociocultural theories of teaching and learning (Engestrőm, 2009) are underpinned by tenets based on how teachers and learners, as social beings, experience teaching and learning though discursive and enacted practices (Ratkić, 2007).

THE STUDY

In order to understand how two of Canada's major cultural-linguistic groups organize graduate seminars, our small-scale ethnographic study examined campus-based graduate teaching practices at one western Canadian English-language faculty of education and one eastern Canadian French-language faculty of education. The study included six participants at each site. Our overarching research question was, "What are the current designs and practices of French- and English-language seminar in Canada?" Data included syllabi, seminar observations, and interviews. Data analysis was conducted in a six-phase cycle: compiling, disassembling, reassembling,

interpreting, visualizing, and concluding. This data analysis cycle allowed us to identify patterns of discernible characteristics of graduate seminar teaching practices.

FINDINGS

As our findings are from a small-scale study, they must be seen as preliminary. Given that limitation, we found evidence of interconnected discernable characteristics of graduate seminar design and teaching practices. Discernable *contextual* characteristics include student enrolments from varied academic programs (for example, PhD, MEd) and professors' associated perceptions of the purposes of specific graduate seminars (knowledge advancement or knowledge application). Discernable *didactique/pedagogical* characteristics include the frequencies of professor-led activities (for example, lectures, presentations, question and answer sessions, etc.), and student-led activities (student-led read and present sessions, student-led discussions, etc.). A third discernable characteristic is continuity (specialization seminars) or diversity (interdisciplinary seminars). Figure 1 presents our findings in a Cartesian plane that illustrates four interconnected patterns discernable graduate seminar design and teaching characteristics.
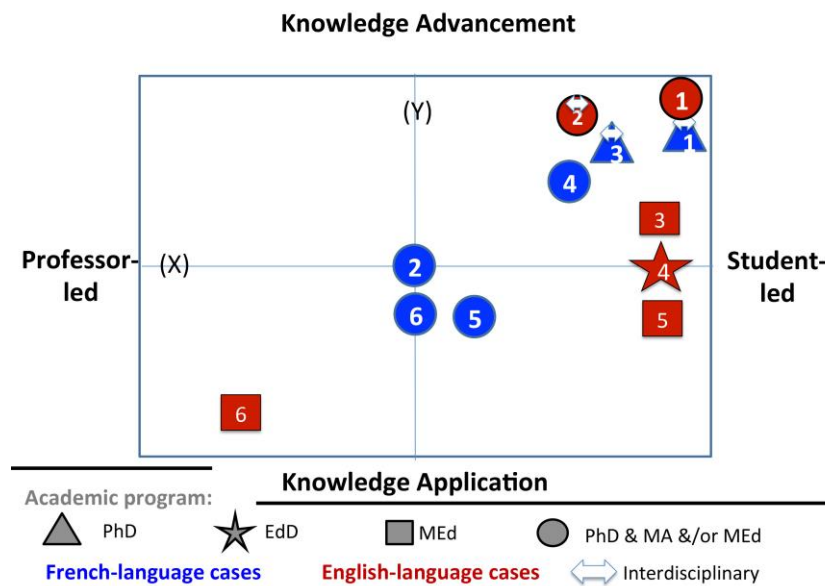
Figure 1: Interrelated discernable characteristics.

DISCUSSION

While Canadian Council of Ministers of Education (2007) statement on quality assurance has six overarching graduate competencies, it also clearly distinguishes among knowledge advancement and application expectations based on degree type. It was not surprising to find that seminars designed for PhD seminars focused on student-led activities, directed toward knowledge advancement (See also: Fejes, Johansson, & Dahlgren, 2005) or that the EdD seminar focused on student-led activities that acknowledged "the professional turn" (Levkoe, Brail, & Daniere, 2014) through designed opportunities for both knowledge advancement and knowledge application to real-world problems. Interdisciplinary seminars, regardless of enrolment, consistently provided student leadership activities directed toward knowledge advancement.

Notable variations were evident in English-language seminars solely designed for MEd students, where designed activities ranged from a strongly professor-led approach to support students

develop marketable job skills (Auten, 2012) to a strongly student-led approach to both knowledge advancement and application (Levkoe, Brail, & Daniere, 2014). Perhaps, the most intriguing cluster of cases are the French-language, mixed-enrolment seminars nearest the intersection of the (x) professor-led to student-led and (y) knowledge-advancement to knowledge-application axes where professors designed activities that incrementally moved from professor to student leadership. Further research is needed to better understand how graduate seminar designs and practices may be influenced by academic traditions, program orientations, and enrolments.

REFERENCES

Auten, J. (2012). Teaching as text - The pedagogy seminar: LIT 730, Teaching composition. *Composition Studies*, *40*(1), 95-112.

Canadian Council of Ministers of Education. (2007). *Ministerial statement on quality assurance of degree education in Canada*. Retrieved from: http://www.cicic.ca/docs/cmec/QA-Statement-2007.en.pdf

Conole, G., Dyke, M., Oliver, M., & Seale, J. (2004). Mapping pedagogy and tools for effective learning design. *Computers & Education*, *43*(1), 17-33.

Costes, N., & Stalter, M. (2010). *Quality assurance in postgraduate education*. Helsinki, Finland: European Association for Quality Assurance in Higher Education. Retrieved from www.enqa.eu/files/ENQA%20workshop%20report%2012.pdf

Council of Graduate Schools and Educational Testing Service. (2010). *The path forward: The future of graduate education in the United States*. *Report from the Commission on the Future of Graduate Education in the United States*. Princeton, NJ: Educational Testing Service.

Eisenberg, A. F. (1999). Forms of socialization: Graduate education and the graduate seminar. Response to "Rethinking the graduate seminar. *Teaching Sociology, 27*(2), 187-191.

Engeström, Y. (2009). Expansive learning: Toward an activity-theoretical reconceptualzation. In K. Illeris (Ed.) *Contemporary theories of learning: Learning theorists…in their own words* (pp. 53-73). New York, NY: Routledge.

Fejes, A., Johansson, K., & Dahlgren, M. A. (2005). Learning to play the seminar game: Students' initial encounters with a basic working form in higher education. *Teaching in Higher Education, 10*(1), 24-87.

Gumport, P. J. (1990). Transformations in American graduate research and education. *Educational Policy, 4*(4), 313-326.

Hopbach, A. (2010). Foreward. In N. Costes, and M. Stalter, (Eds.), *Quality assurance in postgraduate education* (p.6). Helsinki, Finland: European Association for Quality Assurance in Higher Education. Retrieved from www.enqa.eu/files/ENQA%20workshop%20report%2012.pdf

Jaques, D. (2000). *Learning in groups: A handbook for improving group learning*. London: Kogan Page.

Krause, K-L. (2012). Addressing the wicked problem of quality in higher education. Theoretical approaches and implications. *Higher Education Research & Development, 31*(3), 285-297.

Levkoe, C. Z., Brail, S., & Daniere, A. (2014). Engaged pedagogy and transformative learning in graduate education: A service-learning case study. *Canadian Journal of Higher Education, 44*(3), 68-85.

Maurer, S. B. (1999). The role of the area seminar in graduate education. Response to "Rethinking the graduate seminar. *Teaching Sociology, 27*, 174-179.

Nahal, A. (2007). Moving to improve graduate education on an international level. *Issues in Higher Education, 24*(20), 52.

O'Donnell, V. L., Tobbell, J., Lawtham, R., & Zammit, M. (2009). Transition to postgraduate study: Practice, participation, and widening participation agenda. *Active Learning in Higher Education, 10*(1), 26-40.

Parchoma, G. (2004). Learner-centered instructional design and development: Two examples of success. *Journal of Distance Education, 18*(2), 35-60.

Power, T. M., & St. Jacques, A. (2014). The graduate virtual classroom webinar: A collaborative and constructivist online teaching method. *MERLOT Journal of Online Learning and Teaching, 10*(4), 681-695.

Ratkić, A. (2009). Dialogue seminars as a tool in postgraduate education. *AI & Society, 23*(1), 99-109.

Saunders, M. (2011). Setting the scene: The four domains of evaluative practice in higher education. In M. Saunders, P. Trowler, & V. Bamber (Eds.), *Reconceptualizing evaluation in higher education: The practice turn* (pp. 1-17). Maidenhead: Open University Press.

Schwartz, M. D., & Tickamyer, A. R. (1999). Socialization and the graduate seminar. Response to "Rethinking the graduate seminar." *Teaching Sociology, 27*(2), 180-186.

SSHRC. (2013). *Strengthening Canada's cultures of innovation: Strategic plan 2013-2016*.

Retrieved from: http://www.sshrc-crsh.gc.ca/about-au_sujet/publications

/strategic_plan_2013-16-plan_strategique_2013-2016_e.pdf

Steen, S., Bader, C., & Kubrin, C. (1999). Rethinking the graduate seminar. *Teaching Sociology,*

27(2), 167-193.

Tournier, M. (1981). *Tpyologie des formules pédagogiques*. Québec City, QC: Ministère de

l'Education.

Wenger, E. (1998). *Communities of practice: Learning, meaning, and identity*. Cambridge:

Cambridge University Press.

DESIGNING A PROFESSIONAL LEARNING MODEL TO SUPPORT CREATIVITY IN TEACHING AND LEARNING

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This paper explores the considerations in designing professional learning for teachers for the purpose of supporting student creativity. A study of relevant literature informed the design of a professional learning series for teachers in a large urban school board, revealing similarities between creativity, maker education, design thinking, and effective professional learning. Observations indicated that teachers engaged in processes that could support student creativity.

Keywords: Creativity; Maker education; Design thinking; Professional learning

Nearly as soon as I began my role as Learning Specialist in the Learning Innovation service unit in the Calgary Board of Education, I was receiving requests from teachers about several topics related to my portfolios of Learning Commons and Career and Technology Foundations. Teachers were hearing about maker education, and wanted to know what this approach looked like in a classroom. They wanted to know more about designing spaces that enhanced collaboration. They wondered about the Ministerial Order on Student Learning (#001/2013) (Government of Alberta Department of Education, 2013), and how to: "inspire all students to achieve success and fulfillment, and reach their full potential by developing the competencies of Engaged Thinkers and Ethical Citizens with an Entrepreneurial Spirit, who contribute to a strong and prosperous economy and society" (p. 1). The Ministerial Order weaves concepts of creativity throughout, such as collaboration, problem

setting and solving, and divergent thinking (Kelly, 2013). Taken together, these problems of practice were pointing towards the overarching concept of creativity in student learning.

The sheer volume of requests around these topics revealed a need to offer system-based professional learning. This became an opportunity to design a research-based learning series incorporating best practices in effective professional learning, creativity, maker education, and design thinking to enhance student creativity.

LITERATURE REVIEW

A thorough literature review informed the planning of the professional learning. This review revealed few articles focusing on professional learning to enhance creativity. Because of the questions I received from teachers and the absence of literature on professional learning for creativity, research was synthesized from the topics of creativity, maker education, design thinking, and effective professional learning. Design thinking and maker education are manifestations of creativity that are seen by many as being an accessible lens for creativity (Kelly, 2013, p. 8). As such, it was important to identify the distinguishing features of design thinking, maker education, and creativity to find opportunities for alignment with effective professional learning.

The research indicated that there are commonalities between the three creative topics of creativity, maker education, and design thinking, and with effective professional learning. The concepts in common between the four topics would become the foundation of the professional learning series. In the following sections, I will explore this research and how it informed the design of the professional learning series.

Effective Professional Learning

Research supports the idea that presentation-style workshops are ineffective methods of professional learning: "Much of the information gained is not likely to be remembered, and even less likely to be applied once we return to our daily routine" (Hunzicker, 2011, p. 177). Effective professional learning, in contrast, is "active, situated, social, and constructed (Putnam & Borko, 2000)" (as cited in Webster-Wright, 2009, p. 720). Timperley (2011) did an exhaustive synthesis of research on professional learning, finding that the structure of the professional learning had no impact on improvement of student learning. What did have an impact was "the knowledge and skills learned as a result of engagement in the activity or process" (Timperley, 2011, p. 6). Further, Darling-Hammond and McLaughlin (2011) identified characteristics of effective professional learning: it must be inquiry-based, include reflection and experimentation that is participant-driven, must engage teachers in concrete tasks that relate to their every day teaching contexts, must be collaborative, and must be sustained, ongoing, and focused on solving a specific problem of practice. The literature suggested I needed to design the series to immerse teachers in the process, mirroring the skills and knowledge of the topic of creativity. As a result, the activities for the learning series were designed to engage teachers in similar processes they could use with students to engage their creativity. Darling-Hammond and McLaughlin's (2011) research also suggested the professional learning series must focus on a participant-generated problem of practice, and be structured around a collaborative cohort of teachers. To this end, the series was designed as a cohort of teachers who would meet four times throughout the school year to collaborate, and then have time between sessions to experiment and reflect on their learning.

Creativity

Creativity can be difficult to define, simply because of its inherent interdisciplinarity – creativity reveals itself in the arts, sciences, business, education, technology, and design, among other fields (Runco, 2014, p. xi). In attempting to define the process of creativity, it is therefore most useful to use an interdisciplinary definition: Creativity is "bringing ideas or thoughts into forms, ultimately making something out of ideas that can be shared in the currency or medium of the discipline or fields where the creative practice is occurring" (Kelly, 2013, p. 6). For an educator, it is useful to focus on the process of creativity, rather than the product. Kelly (2013) supports this approach by outlining seven strands of creative development: collaboration, self-instigation, research/investigation, generation and experimentation, analysis, and creative sustain (p. 16-18). This framework, and others like it (see Sawyer, 2012, p. 88, for example) are useful in the design of the professional learning series. These frameworks were used in the learning series to allow teachers to approach creativity through the lens of their particular discipline.

Maker Education

Maker education is one approach to creativity in learning. While the concept hands-on learning is not a new pedagogical phenomenon, its current manifestation as maker education is new. Dale Dougherty (2013), one of the founders of the modern maker movement, emphasized that makers "have a sense of what they can do and what they can learn to do" (p. 8). In the context of education, there is value in the maker movement's focus on using hands to explore and create, and put the student at the centre of learning: "Students learn to trust themselves as competent problem solvers who don't need to be told what to do next" (Martinez & Stager, 2014, p. 13). Dougherty (2013) noted that making in education is a creative way for students to learn academic concepts and theory

(p. 10). Through this accessible platform, the professional learning series, entitled *Making Makers* would use maker education as a method of enhancing student creativity.

Design Thinking

Design thinking enhances creativity through a procedural approach to problem solving. Design thinking came from the domain of design, but has found application in many different fields. Design firm IDEO (2012) explained that design thinking is "believing we can make a difference, and having an intentional process in order to get to new, relevant solutions that create positive impact" (p. 11). Design thinking views problems as opportunities, and aligns with effective professional learning in focusing on a context-specific problem of practice. Design thinking takes its practitioner through cyclical phases of creative problem solving: Discovery, interpretation, ideation, experimentation, and evolution (IDEO, 2012). Because it focuses on setting and solving problems, of the three creative approaches, design thinking aligned most closely with effective professional learning, and was therefore selected to both design and structure the professional learning. Like action research, in using design thinking, teachers pose "well-designed questions about their practice, systematically gathering and interpreting data to answer those questions, and consequently taking action to improve practice" (Nolan & Hoover, 2008, p. 104).

COMMONALITIES BETWEEN PROFESSIONAL LEARNING, CREATIVITY, MAKER EDUCATION AND DESIGN THINKING

From the literature, I found similarities between creativity, maker education, design thinking. I have compiled these essential elements in Table 1. These concepts informed the design of the professional learning series.

Concept	Description
Bias Toward Action	All three approaches emphasize the idea of turning thought into form and testing these tangible representations of thought.
Collaboration	Though some parts of all three processes can be done individually, collaboration deepens and broadens the creative process.
Creation (over Consumption)	All approaches emphasize creation of understanding rather than passive consumption of knowledge.
Divergent Thinking	The development of many alternative solutions.
Empathy	Creators put themselves in others' shoes to consider multiple perspectives.
Experimenting	Trying different solutions to solve a problem.
Flexibility	The ability to think of varied ideas.
Growth Mindset (Dweck, 2006)	Creators expect that they will learn from experience, and are ready to modify and assess their weaknesses so they can work towards improving them.
Ideation	Generating ideas, problems, and solutions.
Intrinsic Motivation	Creators are motivated by personal interest and satisfaction rather than external rewards.
Not Rushing	Creativity takes time; the process must not be rushed.
Open Ended	A situation where the outcome is not known.
Open to Experience (Runco, 2014, p. 354)	Creators are open to trying new things.
Optimism	An attitude of hope permeates all three approaches – creators expect a good outcome.
Overcoming Challenges	Creators are motivated to use challenges and mistakes as opportunities for growth.
Permissive	Creators are not bound by excessive rules or protocols.

Problem Finding	Identifying problems that are worth solving.
Questioning Assumptions	Creators question the status quo.
Reflection	Creators are constantly reflecting on the process to understand what to do next.
Solving Problems	Creators solve the problems they found.
Trust	A culture of trust must be built for creators to collaborate.

Table 1: Concepts in common between creativity, maker education, and design thinking.

These key concepts also align with effective professional learning. Good professional learning focuses on experimentation and testing as a key methodology, emphasizing that, "professionals learn through practical experience, and that reflection has a valuable role in learning that requires change, and that such learning is contextually mediated" (Webster-Wright, 2009, p. 720), all of which are evident in Table 1. Reflection is needed for a creator to understand what the next steps are in creative practice, as well as a way for professional learners to look backwards to move ahead. Finally, professional learning is context-dependent, as is creativity.

DESIGN OF THE SERIES

The design of this series was based on my own problem of practice: How might professional learning using design thinking support teachers in designing tasks and processes that engage student creativity? Design thinking's alignment with professional learning was selected as the framework for the series. The process of planning the series using design thinking was an important step in allowing me to experience the processes my participants would undertake.

A cohort of fifteen teachers across grades and subject disciplines volunteered to join this

after-school professional learning opportunity. Teachers participated in four sessions across the course of the school year, experimenting with strategies that focused on creative thinking skills, which are outlined in Appendix A. The series had participants find and define a context-specific problem of practice, collaborate to identify solutions to this problem, experiment with possible solutions, prototype a solution to try in context, and refine and evolve this solution. Participating in activities they might use with their students allowed for "active engagement with experience, while accounting for the importance of context, dialogue, and collaboration" (Webster-Wright, 2009, p. 721). For example, teachers engaged in an activity where they represented their ideas through drawing. Several teachers indicated a desire to use the strategy with their own students. Further examples of activities can be found in Appendix A.

OBSERVATIONS

I was able to observe several factors that indicated that the professional learning series supported teachers in designing ways to engage student creativity. I observed teachers highly engaged in the activities of the professional learning series. The cohort structure built trust amongst participants, enhanced collaboration, which in turn boosted ideation. Every participant designed a solution to their problem of practice and tested it in their own school, suggesting a willingness to change and grow practice.

CONCLUSION

This project aimed to discover how professional learning might support teachers in designing tasks to increase student creativity in the classroom. In planning the professional learning series, a literature review was undertaken to find the similarities between creativity, design thinking, maker education, and effective professional learning, and found concepts in common between all four

topics. This informed the design of a professional learning series. In the series, teachers engaged in design thinking to address a problem of practice in their own context. Observations suggested that teacher-participants applied their learning and engaged in creative tasks and processes in their schools.

REFERENCES

CBE ILT Blog. (2015, March 29). Creativity Tip: Represent Ideas Visually. [Web log post]. Retrieved from http://cbeilt.blogspot.ca/2015/03/creativity-tip-represent-ideas-visually.html

Darling-Hammond, L., & McLaughlin, M. W. (2011). Policies That Support Professional Development in an Era of Reform. *Phi Delta Kappan*, *92*(6), 81–92. doi:10.1177/003172171109200622

Dougherty, D. (2013). The maker mindset in Honey, M. & Kanter, D.E. (Eds), *Design, make, play: growing the next generation of STEM innovators*. (pp. 7 – 11). New York, NY: Routledge.

Dweck, C.S. (2008). *Mindset: the new psychology of success*. New York, NY: Ballantine Books.

Government of Alberta Department of Education (2013). *Ministerial Order (#001/2013)*. Retrieved from https://education.alberta.ca/media/6950988/mostudentlearning.pdf

Hunzicker, J. (2011). Effective professional development for teachers: a checklist. Professional Development in Education, 37(2), 177–179. doi:10.1080/19415257.2010.523955

IDEO (2012). *Design thinking for educators toolkit*. Retrieved from http://designthinkingforeducators.com

Kelly, R.W. (2012). *Educating for creativity*. Calgary, Alberta: Brush Education Inc.

Martinez, S. L., & Stager, G. S. (2014, May). The maker movement: a learning revolution. *Learning & Leading with Technology, 41*(7), 12-17. Retrieved from http://go.galegroup.com.ezproxy.lib.ucalgary.ca/ps/i.do?id=GALE%7CA367544205&v=2.1&u=ucalgary&it=r&p=AONE&sw=w&asid=01a885b9d1feef5ef5edc49ccb105a8e

Nolan, J., & Hoover, L. (2008). *Teacher supervision and evaluation: Theory into practice*. Hoboken, NJ: John Wiley.

Runco, M. A. (2014). *Creativity: Theories and themes: research, development, and practice (2nd edition)*. Saint Louis, MO, USA: Academic Press. Retrieved from http://www.ebrary.com

Sawyer, R. K. (2012). *Explaining creativity: the science of human innovation (2nd edition)*. Cary, NC, USA: Oxford University Press, USA. Retrieved from http://www.ebrary.com

Telus Spark. (n.d.) *So you think you can't draw*. Retrieved from http://sparkscience.ca/assets/Documents/Educators/TELUSSparkWorkshopSoYouThinkYouCantDraw.pdf

Timperley, H.S. (2011) *Realizing the power in professional learning*. Berkshire, England: McGraw-Hill Education.

Webster-Wright, A. (2009). Reframing professional development through understanding authentic professional learning. *Review of Educational Research, 79*(2), 702–739. doi:10.3102/0034654308330970

APPENDIX A: OUTLINE OF MAKING MAKERS PROFESSIONAL LEARNING

Timeline	Design Thinking Phase	Activities
November 2014	Overview	• Webinar to introduce the series.
November 2014	Discovery	• Participants introduce themselves sharing a metaphor for themselves, to start establishing a culture of trust • Engage in ideation to begin identifying problems of practice • Engage in collaborative brainstorming to increase ideation: Speed Dating Idea Exchange (Kelly, 2012) • Homework: Select one problem of practice.
January 2014	Discovery Interpretation	• Collaborative ideating: Write problem of practice on chart paper. All participants use post-its to suggest possible solutions to problem of practice of colleagues. • Introduce concept of representing ideas visually with "So You Think You Can't Draw" (Telus Spark, n.d.) • Homework: Select one solution.
March 2015	Interpretation Experimentation	• Further refine solution through drawing (see "Creativity Tip: Represent Ideas Visually," March 29, 2015). • Participants create a prototype of the solution to test in their own schools. • Homework: Test the solution and seek feedback from users. • Participants can access to system-owned maker education tools that they can use in their solution
May 2015	Evolution	• Reflect on the solution and how it could be evolved

SMALL FLICS TO BIG FLIPS: A STEP-BY-STEP GUIDE TO FLIPPING YOUR CLASSROOM

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Flipped learning is becoming an increasingly popular and researched educational practice in higher education. Current research and models provide theoretical frameworks and supporting evidence for flipped learning. Yet, the notion of flipping a classroom is daunting and many instructors do not know where or how to begin. The (Flipped Learner-Centred Interactive Classroom Strategies) FLICS model provides a practical process for designing flipped learning environments. This paper discusses flipped learning, presents FLICS along with practical implementation strategies, and attempts to answer some of the common questions and concerns when creating a flipped learning environment.

Keywords: Flipped learning; Flipped classroom; Active learnig; Education technology

LITERATURE REVIEW

Flipped learning moves content delivery outside of the classroom and in its place engages students in active problem solving and knowledge creation in the classroom (Bergmann & Sams, 2014). Adapted from the Flipped Learning Network's (FLN, 2014) definition of flipped learning, we define flipped learning as a pedagogical framework to facilitate meaningful student learning experiences using active learning strategies. Flipped learning utilizes online interactive instruction, content exploration and student collaboration while the classroom space is transformed into an

interactive learning environment where the students work together and with the instructor to apply their knowledge, test their assumptions and receive feedback on their learning.

The use of flipped learning has already been shown to have a positive impact on student learning due to several reasons (Gilboy, Heinerichs, & Pazzaglia, 2015; Herried & Schiller, 2013; Tune, Sturek, & Basile, 2013). First, because the in-class activities increase the instructor-student contact time, students are better able to ask questions to clarify concepts as they work (Lage, Platt, & Treglia, 2000). Second, flipped learning also provides students with opportunities for instant feedback not only from the instructor but also from their peers (Bergmann & Sams, 2012). Students have reported the value of working with other students in this environment (Strayer, 2012) and some students have reported relying on group work to achieve better understanding of concepts (Lage et al., 2000). Third, by putting content online using media, students can be selective in the content they view and when they view it (Gerstein, 2012; Moffett, 2014), take advantage of content from different sources (Gerstein, 2012), and move at their own pace (Fulton, 2012).

FLICS MODEL

There are a few models that depict how flipped learning could be structured. For example, experiential engagement, concept exploration, meaning making, and demonstration and application are the four components that Gerstein's model (2012) connects together to create flipped learning. Strayer (2011) has a more process-oriented visualization that makes the connection between educational technology and learning through activity to influence the learning environment. Although these models provide a theoretical overview of flipped learning, they do not emphasize the process of how to create a flipped learning environment. The Flipped

Learning-Centred Interactive Classroom Strategy (FLICS) is a sequential model to help instructors adopt flipped learning.

FLICS is based on current literature and builds on the idea that components of the traditional classroom can be re-arranged by *flicking* each component to either the online or classroom learning spaces to create the flipped learning environment. By starting small, FLICS is based on the idea that microflips (Buemi, 2014) can be used to create flipped lessons. Moreover, FLICS is based on the seven principles of good teaching and learning (Chickering & Gamson, 1987) in that it 1) encourages contact between students and instructors both online and in the classroom, 2) develops reciprocity and cooperation among students by providing collaborative activities online and in the classroom, 3) encourages active learning with online activities such as simulations and time in class for participatory learning, 4) has space for timely feedback either through online interactions or in the classroom, 5) emphasizes time on task by focusing, planning and linking online content with in class activities, 6) encourages the communication of high expectations to students to ensure they come to class prepared to participate, and 7) respects diverse talents and ways of learning by providing a variety of content presentation methods and opportunities for students to take ownership of their learning.

As illustrated in Figure 1, FLICS makes use of both *blocks* and *flicks* to plan individual lessons that connect learning outcomes with the associated student assessment. *Blocks* are broad and help an instructor visualize the distribution of content, application of knowledge, and student engagement between the online and classroom environments. The content *block* can include knowledge, skills and concepts, while the application *block* is how students will use the content. The student engagement *block* prompts the instructor to include activities to engage students with each other, the instructor, and the content to facilitate meaningful learning. Consider these *blocks* as fixed

containers that do not change in size; this way, the instructor is encouraged to be intentional with what goes into each block. *Flicks* are the specific teaching and learning practices that are strategically used both online and in the classroom, and can vary between lessons and courses.
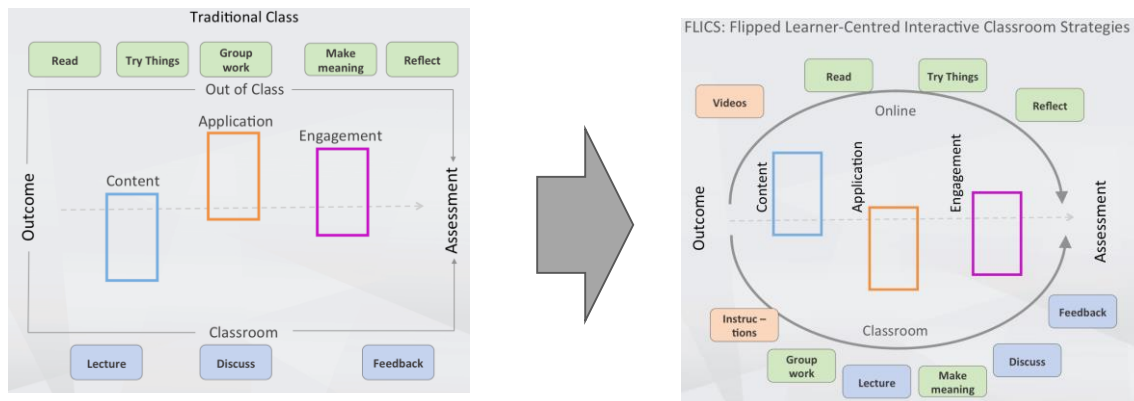
Figure 1: Comparison of Traditional Classroom to FLICS

USING FLICS

The following two phases and associated steps outline how to use the FLICS model to plan a flipped lesson.

Phase 1: Establish the blocks

Step 1: Set the end parameters by writing clear and measureable learning outcomes, and determine student assessment strategies.

Step 2: Identify which content supports the learning outcomes and select content for the online and classroom environments.

Step 3: Select activities for both the online and classroom environments for students to apply content and skills. Maintain a focus on supported active learning in the classroom.

Step 4: Plan how to engage students for both the online and classroom environments.

Phase 2: Do the Flicks

Step 1: Flick selected content online using videos, podcasts, and readings. Ensure content is concise (i.e., podcasts should be no more than 10 minutes and focus on one topic).

Step 2: Flick short activities online such as simulations or games for students to try things out and receive feedback.

Step 3: Flick any group work or problem-solving activities into the classroom where students work together, create meaning, and receive clarification. Plan for individual work time as well when appropriate.

Step 4: Flick instructions and short mini-lessons into the classroom. Often, short lessons are required to provide students with further content at the beginning or during the class.

Step 5: Flick feedback into the classroom to provide students with immediate feedback on their learning. When the course consists of multiple sections, correct answers can be provided online at a later time, but preferably before the next class.

Step 6: Flick opportunities for student reflection of their learning online.

By following these steps, FLICS provides a flexible process to flip a lesson or module.   Individual flipped lessons can then be linked together over time to flip an entire course (see Figure 2).

Figure 2: Linking FLICS together to create a flipped course.

ADVANTAGES OF USING THE FLICS FRAMEWORK

The FLICS framework is built around the notion that flipped learning is flexible and adaptable to instructors' needs, as highlighted by Bergmann and Sams (2014). Flipped learning provides instructors the flexibility to check in with students (Lage et al., 2000) to not only inform student learning, but also the instruction. The flexibility of FLICS allows for real-time changes during the lesson, module or course by re-arranging or adding additional *flicks* to address immediate student and instructor concerns.

Moreover, as the *flicks* in the FLICS framework are interchangeable depending on the learning situation, FLICS is flexible to learner needs. To maintain a learner-centred focus, FLICS emphasizes the importance of linking all teaching and learning elements to learning outcomes. As underlined by Bergmann and Sams (2012), FLICS highlights the importance of identifying which learning outcomes are best achieved by students through direct instruction or through inquiry.

Challenges and questions of flipped learning

Through offering professional development workshops using FLICS, the authors have collected and provided answers to the following common questions and concerns about flipped learning and the FLICS framework in higher education.

How do I ensure students come to class prepared?

As flipped learning creates an environment for students to take ownership of their own learning (Bergmann & Sams, 2012; Lage et al., 2000), it is recommended that low-stakes mini-quizzes be used to encourage students to complete any online, pre-class work. Moreover, it is important to design in-class activities that are strongly linked to pre-class material. By setting clear expectations for each lesson, students can see the purpose of both online and in-class activities.

What types of assessments are most appropriate in a flipped classroom?

Assessments must be clearly linked to both the online and in-class material, and they should require application of knowledge and concepts. Preferably, these assessments should contain questions that have multiple correct answers so that student collaboration and rich discussions are encouraged.

How much time does it take to record a 10-minute podcast or video?

Using the FLICS framework, instructors can create their own podcasts to deliver online material using a variety of either freely- or commercially-available software programs. The most effective podcasts are those whose learning outcomes are clear and tied to specific classroom or online activities. Videos should also not be longer than 10 minutes in length and focus on one topic (Bergmann & Sams, 2012). It is recommended to write a script and generally a 10-minute podcast takes on average 60 minutes to create. The benefit is that podcasts can be viewed many times by students, paused, and replayed. Instructors can also take advantage of existing content and resources such as videos by Khan Academy or from other experts in the field (Gerstein, 2012).

How are student groups managed in class?

Group work in a flipped learning environment is encouraged, and can be managed both informally and formally with group contracts and agreements, regardless of how groups are made. Moreover, from our experience assigning individual roles to each group member such as leader, recorder, time keeper and reporter can help create a sense of responsibility to their group. There are also several different rubrics that can be used to make use of peer evaluations and provide overall group scores or scale individual assessment marks (Michaelson, Knight & Fink, 2002).

How can I still cover all the content I used to?

The FLICS framework requires the instructor to be very selective in course content to provide appropriate tools so that students can be responsible for their own learning and achieve the intended learning outcomes. It is important that the content container does not expand; meaning flipped learning is not a means for more content. Lage et al. (2000) found that course coverage was not sacrificed in a flipped learning environment; instead, there was more time in class for student-instructor interactions.

What if the students resist?

Student resistance is defined as negative student reactions observed when new teaching approaches are used (Seidel & Tanner, 2013). Seidel and Tanner (2013) suggest a number of different strategies that can be used to prevent it, which include practicing instructor immediacy, being transparent about pedagogical choices, and structuring group activities to promote fairness.

SUMMARY

Flipped learning has benefits for both students and instructors (Bergmann & Sams, 2014; Lage et al., 2000; Strayer, 2012). FLICS provides a practical and flexible framework to flip a lesson or entire course. By starting small, FLICS provides boundaries to intentionally select teaching and learning practices to facilitate a rich and meaningful student-centred learning environment.

REFERENCES

Bergmann, J., & Sams, A. (2012). *Flip your classroom. Reach every student in every class every day*. Eugene, Oregon:ISTE

Bergmann, J., & Sams, A. (2014). *Flipped learning: gateway to student engagement*. Eugene, Oregon:ISTE.

Buemi, S. (2014, April 21). Microflipping: a modest twist on the 'flipped' classroom. *The Chronical of Higher Education*. Retrieved from http://chronicle.com

Chickering, A., & Gamson, Z. (1987). *Seven principles for good practice in undergraduate education*. AAHE Bulletin, 39, 3-7. Retrieved from http://files.eric.ed.gov/fulltext/ED282491.pdf

Flipped Learning Network (2014, March). *Definition of flipped learning*. Retrieved from http://www.flippedlearning.org/definition

Fulton, K. (2012). Upside down and inside out: Flip your classroom to improve student learning. *Learning & Leading with Technology, 39*(8), 12–17.

Gerstein, J. (2012*). Flipped classroom: The full picture for higher education*. Retrieved from http://usergeneratededucation.wordpress.com/2012/05/15/flipped-classroom-the-full-picture-for-higher-education/

Gilboy, M.B., Heinerichs, S., & Pazzaglia, G. (2015). Enhancing student engagement using the flipped classroom. *Journal of Nutritional Education and Behavior*, *47*(1), 109-114.

Herried, C.F., & Schiller, N.A. (2013). Case studies and the flipped classroom. *Journal of College Science Teaching*, *42*(5), 62-66.

Lage, M.J., Platt, G.J., & Treglia, M. (2000). Inverting the Classroom: A gateway to creating an inclusive learning environment. *The Journal of Economic Education*, 31(1), 30-43

Michaelson, L.K., Knight, A.B., & Fink, D.L. (2002). *Team-based learning: a transformative use of small groups*. Westport, CT: Preager Publishers

Moffett, J. (2014). Twelve tips for "flipping" the classroom. *Medical Teacher 37*(4), 331- 336 doi: 10.3109/0142159X.2014.943710

Seidel, S.B., & Tanner, K.B. (2013). "What if students revolt?" – considering student resistance: Origins, options, and opportunities for investigation. *CBE Life Science Education*, *12*(4), 586-595.

Strayer, J. (2012). How learning in an inverted classroom influences cooperation, innovation and task orientation. *Learning Environments Research*, *15*(2), 171-193. doi:10.1007/s10984-012-9108-4

Strayer, J. (2011). *The flipped classroom*. Retrieved from http://www.knewton.com/flipped-classroom

BUILDING DIGITAL VIDEO GAMES AT SCHOOL:

A DESIGN-BASED STUDY

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Teachers and administrators in many Canadian schools are especially concerned about developing innovative ways that can intellectually engage their students in deep learning of core curriculum content, while equipping them with 21st century competencies. In this paper, we discuss some key ideas on how an intervention, a video game design and building process, was implemented as an innovative practice in four grade 6 social studies classes at a Calgary charter school. Utilizing a design-based research approach, the research design team explored and evaluated the effectiveness of the design in addressing the intervention and learning goals, and list some key findings and implications from the study.

Keywords: Building digital video games; Design-based study; Teachers' design of instruction and learning tasks

With the continuing impact of new and more sophisticated emerging technologies on teaching and learning environments, teachers and administrators in many K-12 Canadian schools are concerned about finding innovative methods and instructional strategies to intellectually engage students in a deeper learning and understanding of core curriculum content and to equip them with 21st century competencies (e.g., critical thinking, problem solving and decision making, creativity and innovation, communication, collaboration and teamwork, living in the world - citizenship, local

and global, life and career [adapted from Binkley et al., 2010]). As such, teachers and administrators aim to use instructional strategies that have the potential to challenge students in meaningful and authentic ways (Dunleavy & Milton, 2009)—different 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 have attempted to address this concern by embracing a culture of inquiry in which students become engaged or more involved in their learning to create or build new understandings, meanings, and sharing of knowledge using technology (Alberta Education, 2014). However, many of these attempts are offset by the underlying influence of the industrial-aged or standardized models of education in a majority of school communities (Sawyer, 2007). The standard model "revolve[s] around the teacher who delivers a one-size-fits all, one-way broadcast learning, . . . 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 the majority of instructional time comprises seatwork and whole-class instruction led by the teacher (Jacobsen & Friesen, 2011). 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).

In this paper, the authors discuss how a collaborative effort initiated by a research design team addressed teachers' and administrators' concerns about learning (as identified in paragraph 1) by carrying out an experiment through a designed solution/intervention, a video game design and building process, using a design-based research (DBR) approach. The team comprised a researcher/designer/observer/participant, two grade 6 practitioners/designers, their students (100)

and a professional development leader at a charter school in Calgary. The discussion in this paper is organized in three sections: (1) the designed solution/intervention/video game design and building process; (2) the implementation of the video game design and building process in the teaching and learning context; (3) initial key findings of this study with some implications of these findings for learning theory and practice.

DESIGNED SOLUTION/VIDEO GAME DESIGN AND BUILDING PROCESS

The designed framework for the video game design and building process in this study is based on a situated learning theoretical framework; specifically, Herrington and Oliver's (2000) nine-element framework comprised of planning, game concept development, storyboarding and programming (with try-out component) tasks. The designed framework is a collaboratively re-modified design by researcher and practitioners after two iterations of the initial designed framework proposed to the practitioners, which was informed by an assessment of the problem and attempts to address the gap discovered in previous findings and views of other researchers on the design and building of video games as an effective game-based learning pedagogy. Empirical research has shown that using game design and building in school seems to enhance students' active learning and understanding of subject content, intrinsic motivation, deep learning strategy use, concentration and engagement, the fostering of higher order thinking, development of technological fluency skills, decision-making skills and new ways of thinking, in most instances (Kafai, 2006; Li, 2010; Yang & Chang, 2013). However, other research has reported concerns about the effective adoption of this game design-based learning approach for pedagogical usability in school (Tzuo, Isabelle, Ling, Yang & Chen, 2012).

IMPLEMENTATION OF VIDEO GAME DESIGN & BUILDING PROCESS

An exploration and assessment/evaluation of the video game design and building process as an effective innovative method or instructional strategy was carried out during its implementation using a design-based research approach, more specifically, in one macro cycle of the design-based research process (as seen in Figure 1) and guided by two 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/understanding of core curriculum content and to develop 21st century competencies 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/understanding of core curriculum content, and the development of 21st century competencies?
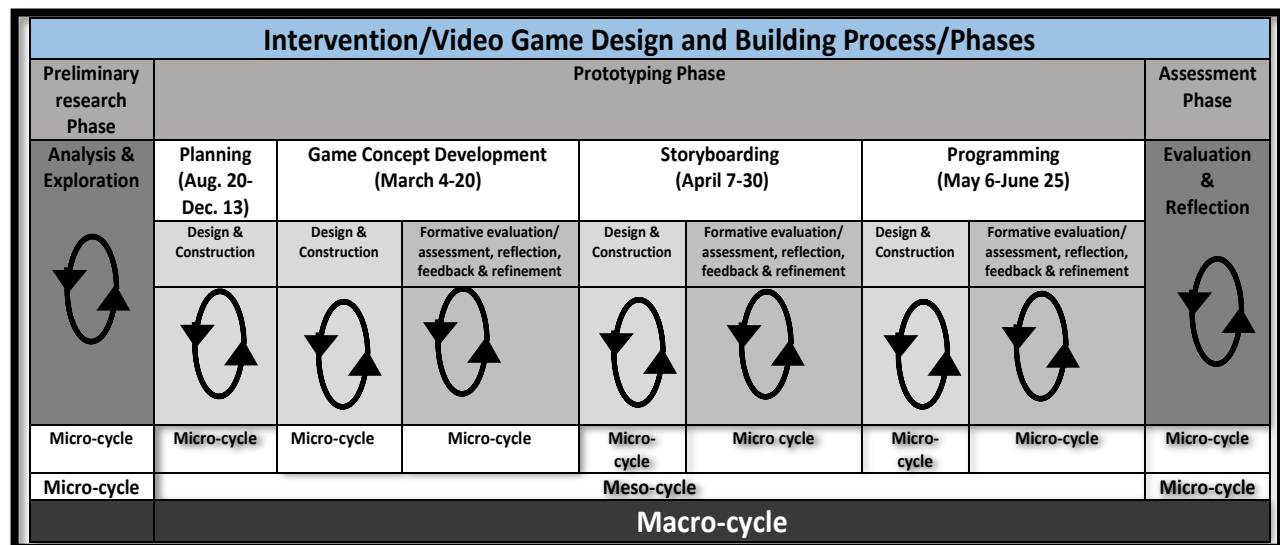

Figure 1: Macro-cycle of the intervention/video game design and building process adapted from

Preliminary research phase/analysis and exploration phase

One micro-cycle of the analysis and exploration phase was mostly carried out before approaching the practitioners/teacher participants. The researcher, as designer, actually began collaborating

with the teacher participants by presenting and discussing the research-informed problem with them based on the teacher's own needs and the proposed research-informed designed solution/intervention, a video game design and building process. Subsequently, the teacher participants were familiarized with the entire research process to help inform their adoption and implementation of the solution in their social studies classes.

Prototyping phase

The implementation of the prototyping phase in the classroom took place in both planned and unplanned processes. The planned processes included the intended goals, methods and strategies and were implemented through one planning task and three learning tasks—game concept development, storyboarding and programming (see Figure 1). The planning task comprised one micro-cycle of design and construction. It was used to plan the implementation of the three learning tasks, identify the learning goals for the video game design and building process, and the curriculum content to help students specify the domain knowledge they should know in designing and building their video games as they attempted to solve the designed problem guided by the question, How did/do the citizens participate in the decision-making process? The unplanned processes, on the other hand, were the "side effects or the unintentional fringe benefits and/or negative consequences brought about by [the] intervention . . . [as well as] those created by practitioners who (intentionally or not) alter interventions" (McKenney & Reeves, 2012, p.161), and which became evident as the learning tasks were implemented. 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. The curriculum content or given topics 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, 2005). The three learning tasks, game concept development, storyboarding and programming each comprised a meso-cycle of this phase—the design and construction informed by a formative evaluation/assessment, reflection, feedback and refinement strategy. As part of their design of instruction, which comprised an instructional framework with a variety of instructional activities with task-specific activities/ideas guided by design principles, teacher participants employed the design strategy to progressively refine and promote the effectiveness of the learning tasks, particularly, the game concept development and storyboarding. In the programming task, however, this strategy tended to be used more by the students/groups as the teacher participants took more of a hands-off approach during programming. Characteristic of DBR in general, a mixed-methods design, specifically, an embedded design (Creswell, 2012), was employed to collect data in this study. Quantitative and qualitative data were collected sequentially, before, during and after the prototyping phase, and analyzed to inform/address the implementation and iterations of the learning tasks and the research questions.

Assessment phase/evaluation and reflection phase
The assessment phase/evaluation and reflection phase represented the final stage of the video game design and building process. The main purpose of this phase was to conclude whether the intervention did address the research questions and by extension, was effective as an innovative practice/instructional strategy.

SOME KEY FINDINGS OF THIS STUDY
In addressing the research questions, some key findings emerged from this research. Based on their interview responses, teacher participants indicated that some of the ways they needed to

shift/modify their design of instruction, which impacted the design of the learning tasks, more particularly, the game concept development and storyboarding tasks, included the following: i) employed more interaction modes to collaborate and communicate during these tasks, ii) used more extensive coaching and scaffolding, iii) continuously used various forms of assessments with feedback loops that also reflected the context and the nature of their students, which they deliberately developed and adapted as the process continued to assess students' progress, and iv) used 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.

Based on researcher observation, teacher and students' mid- and post interview responses, students' blogged experiences, assessment rubrics and student game artifacts, study findings indicated that deeper learning and understanding of the curriculum content seemed most apparent/evident as all students/groups collaboratively brainstormed story ideas, formulated effective questions, researched the curriculum content, discussed, developed their stories/game concepts, storyboarded game concepts and built game prototypes. Deeper learning and understanding of role-specific skills and game features also seemed evident as students/groups storyboarded their game concept ideas. Teacher participants, however, stated that deeper learning of curriculum content did not seem as apparent/evident in the resulting game artifacts. Overall, the storyboarding task seemed to represent the area of deepest learning and understanding of the curriculum content, while the programming task seemed to represent the area of deepest learning about game development, and mostly of the game platform/Scratch.

Based on their observation throughout the process, teacher participants stated that intellectual engagement seemed to be an inherent feature or "by-product" of the overall process. Approximately 92% of the students/groups indicated that the activities in the process tended to

stimulate and sustain their interest, which was 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, while approximately 79% indicated that were highly motivated to complete the programming task. Approximately 83% of the students/groups also indicated that they had experienced that flow state, while all students/groups indicated that they enjoyed and had fun while engaging in the whole process. Overall, findings seemed to indicate that the storyboarding task represented the area of highest intellectual engagement, while the programming task represented the area of lowest intellectual engagement, although intellectual engagement was still present in each task during the process.

Based on their observation throughout the process, teacher participants also stated that, like intellectual engagement, development of 21st century competencies seemed to be an inherent feature or "by-product" of the process. All students seemed to become even more proficient and skilled in all the 21st century competencies as the process continued through the storyboarding and programming tasks. It was observed that problem solving and decision-making seemed to be the most evident competencies used in all three learning tasks. It was also observed that creativity, collaboration/teamwork, communication and preparing for their future as they developed skills to participate in the real world context seemed to represent the most developed 21st century competencies throughout the storyboarding and programming tasks.

To conclude, study findings have implications for practice and provide theoretical support for instruction based on the actual theoretical underpinnings that emerged as the teacher participants shifted/modified their design of instruction and learning tasks. Design principles emerged to guide the design of the activities in the game design context as a result of the identified shifts in instruction. The effectiveness of the process as an innovative practice in school and a designed

framework for the video game design and building process can be used as a model in other school contexts. The process is a disruptive and more participatory, collaborative and authentic learning environment/context than standardized instruction. Future iteration/refinement of this designed framework for possible long-term effectiveness and impact into similar and other school contexts is a next step for research and for practice. Finally, study findings can impact policy for future implementation of the game design and building process as an innovative practice in school.

REFERENCES

Alberta Education. (2005). *Social studies kindergarten to grade 12*. Retrieved from http://education.alberta.ca/media/774369/ss6.pdf

Alberta Education. (2014). *Guide to education: ECS to grade 12, 2014-2015*. Retrieved from https://education.alberta.ca/media/8765464/guide_to_education_2014.pdf

Binkley, M., Erstad, O., Herman, J., Raizen, S., Ripley, M. & Rumble, M. (2010). *Draft white paper 1: Defining 21st century skills* [White paper]. Retrieved from http://atc21s.org/wp-content/uploads/2011/11/1-Defining-21st-Century-Skills.pdf.

Creswell, J. W. (2012). *Educational research: Planning, conducting and evaluating quantitative and qualitative research*. Pearson Education: Boston, MA. Retrieved from http://basu.nahad.ir/uploads/creswell.pdf

Dunleavy, J. & Milton, P. (2009). *What did you do in school today? Exploring the concept of student engagement and its implications for teaching and learning in Canada*. Toronto: Canadian Education Association.

Herrington, J. & Oliver, R. (2000). An instructional design framework for authentic learning environments. *Educational Technology Research and Development, 48*(3), 23–48.

Jacobsen, D. M. & Friesen, S. (2011). Web exclusive: Hands on vs. hands up: Technology-enabled knowledge building in high school. *Education Canada*, *51*(3). Retrieved from http://www.cea-ace.ca/education-canada/article/web-exclusive-hands-vs-hands-technology-enabled-knowledge-building-high-sch

Kafai, Y. B. (2006). Constructionism. In R. K. Sawyer (Ed.). *The Cambridge handbook of the learning sciences*. New York: Cambridge University Press.

Kebritchi, M. & Hirumi, A. (2008). Examining the pedagogical foundations of modern educational computer games to inform research and practice. *Computers & Education*, *51*(4), 1729–1743.

Li, Q. (2010). Digital game building: Learning in a participatory culture. *Educational Research*, *52*(4), 427–443.

McKenney, S. & Reeves, T. C. (2012). *Conducting educational design research*. New York, NY: Routledge.

Parsons, J. & Taylor, L. (2011). *Student engagement: What do we know and what should we do*? AISI University Partners, Edmonton: Alberta Education. Retrieved from http://education.alberta.ca/media/6459431/student_engagement_literature_review_2011.pdf

Sawyer, R. K. (Ed.). (2006). *The Cambridge handbook of the learning sciences*. New York, NY: Cambridge University Press.

Sawyer, R. K. (2007). *Optimising learning: Implications of learning sciences research*. OECD/CERI International Conference Learning in the 21st Century: Research, Innovation and Policy. Retrieved from http://www.oecd.org/dataoecd/39/52/40554221.pdf

Tapscott, D. (2009). *Growing up digital: How the net generation is changing your world*. New York: McGraw-Hill.

Tzuo, P. W., Isabelle, J., Ling, O. P., Yang, C. H. & Chen, V. H. H. (2012). Re-conceptualizing pedagogical usability of and teachers' roles in computer game-based learning in school. *Educational Research and Reviews*, 7(20), 419-429. DOI: 10.5897/ERR11.072

Yang, Y. T. C. & Chang, C. H. (2013). Empowering students through digital game authorship: Enhancing concentration, critical thinking, and academic achievement. *Computers & Education*, 68,334-344.

BUILDING TEACHERS' CAPACITY IN AUTHENTIC ASSESSEMNT AND ASSESSMENT FOR LEARNING

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This paper reports on an ongoing research project that aims to build teachers' capacity in authentic assessment and assessment for learning. Using a critical inquiry approach, five Grade 6 teachers from a charter school are engaged in reflecting on their conceptions of assessment. They are also involved in authentic assessment task design during bi-weekly professional learning community meetings. The data sources include focus group, analysis of assessment tasks and associated student work samples, teacher and student interviews. The mathematics authentic assessment co-designed by the teachers and its implications on their conceptions of assessment and on student learning will be discussed.

Keywords: Building teachers' capacity; Authentic assessment; Assessment for learning; Assessment task design; Professional learning community; Mathematics

INTRODUCTION

In the era of competency-based curriculum and outcome-based reporting, building teachers' capacity in authentic assessment and assessment for learning (AfL) is one of the key priorities in

in-service teacher education and professional development. Authentic assessment refers to assessment tasks that replicate the real-world challenges and standards of performance that typically face experts or professionals in the field (Wiggins, 1989). AfL connotes the use of assessment to help and promote student learning (Stiggins, 2002). To help students develop the 21st-century competencies such as critical thinking, creative problem solving, collaboration, communication, and self-directed learning, teachers need to be equipped with the knowledge and skills in selecting, adapting, and designing classroom assessment tasks that are well aligned with the competency-based curriculum. At the same time, teachers are expected to be competent in engaging students in AfL, which in turn will lead to the development of dispositions such as self-regulated learning, inquiry habits of mind, and lifelong learning. Hattie's (2003) meta-analytic study has shown that the quality of teachers can make a difference to student learning and achievement. Teachers' professional learning and reflections on their classroom practices will lead to improvements only when it is done collectively with their colleagues in a collegial, non-threatening environment and when it is based on actual evidence of student learning (Hattie as cited in DuFour & DuFour, 2010; Wiliam & Thompson, 2008). This paper reports on an ongoing research project that aims to build teachers' capacity in designing and implementing authentic assessment and AfL.

To date, there are several intervention studies in the area of building teachers' capacity in authentic assessment and assessment for learning (AfL) through more sustained form of professional development (Koh, 2011; Sato, Wei, & Darling-Hammond, 2008; McMunn, McColskey, & Butler, 2004; Wiliam, Lee, Harrison, & Black, 2004). These studies have been conducted in the Non-Canadian context. The researchers have found positive effects of teachers' active involvement in designing and implementing authentic assessment tasks and AfL strategies (i.e., formative

feedback, self-assessment, and peer assessment) on the quality of student learning and achievement. Additionally, the use of an inquiry stance for building teacher capacity is deemed to enable more effective teacher learning and professional development (Cochran-Smith & Lytle, 2009; Wyatt-Smith & Gunn, 2009).

Empirical studies in the eastern provinces of Canada have shown that the majority of teacher candidates reported a low level of assessment literacy (DeLuca & Klinger, 2010; Volante & Fazio, 2007), especially in new forms of assessment such as authentic assessment and AFL. The western provinces of Canada, Alberta included, have moved towards improving teachers' assessment literacy through school-based professional development based on professional learning communities (PLCs). However, these initiatives have not been altogether successful. Sumara and Davis's (2009) study showed that many of the school-based PLCs had failed to produce deep change in school cultures due to a lack of teachers' bottom-up initiatives.

The Alberta context

Since the implementation of the Alberta Initiative for School Improvement (AISI) in the last decade, some snapshots of the evidence of AfL on student achievement have been documented in individual schools. The AISI funding ended in March 2013 due to provincial budget cuts. In the final report of the Alberta Student Assessment Study (Weber, Aitken, Lupart, & Scott, 2009), three main barriers to student assessment in the Alberta education system were identified: (1) teachers' weak understanding of fair assessment practices, (2) teachers' lack of understanding of external or perceived "high-stakes testing" purposes, and (3) the effects of inappropriate assessment of at-risk students. Many teachers in Alberta schools were also found to have limited curricular outcomes by favoring rote memorization techniques over those that promoted deep learning and student engagement.

Under the vision of the Inspiring Education in Alberta, students in Alberta schools are expected to master literacy and numeracy and 21st-century competencies, which enable them to become engaged thinkers and ethical citizens with an entrepreneurial spirit. In line with other high-performing education systems around the world, the following 21st-century competencies are desired in the Alberta Curriculum Framework for Student Learning: critical thinking and problem solving; creativity and innovation; social responsibility and cultural, global and environmental awareness; communication; digital literacy; collaboration; lifelong learning, self-direction and personal management (Alberta Education, 2011). To be aligned with the desired educational outcomes in the curriculum framework, two new assessment initiatives have recently been introduced: (1) a replacement of the Provincial Achievement Tests (PAT) in Grades 3, 6, and 9 with Student Learning Assessments (i.e., a series of new computer-based tests), and (2) teachers' use of performance assessments in Mathematics, English Language Arts, and Science (Alberta Assessment Consortium, 2013). However, the success of these initiatives requires Alberta teachers to be competent in assessing students' mastery of core subject areas and some of the essential 21st-century competencies, such as creativity, critical thinking, problem-solving, communication, collaboration, and self-regulated learning. At the same time, Alberta teachers will need to be able to use assessment information to provide quality feedback to students and parents. Provision of quality feedback is one of the key AfL strategies (Hattie & Timperley, 2007; Sadler, 1998). These new requirements indicate that the roles of authentic assessment and AfL have become increasingly important in Alberta teachers' day-to-day instructional practices. Oftentimes, ad-hoc, one-off workshops focus only on teachers' learning of the procedural skills of task design and rubric development in a mechanical way. As a result, teachers' realizations of quality assessment in actual classrooms are limited.

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PURPOSE OF THE STUDY

The study aims to use a critical inquiry approach to building teachers' capacity in authentic assessment and AFL through school-based professional learning community (PLC). Specifically, five Grade 6 teachers from a Calgary charter school are actively engaged in critical inquiry of their conceptions of authentic assessment and AfL as well as assessment task design during bi-weekly PLC meetings. The PLC meetings are co-facilitated by a university researcher and a lead teacher. Teachers' awareness and engagement in assessment task design has been recognized as one of the promising pedagogical approaches in helping teachers develop an understanding of student learning (Shepard, et al., 2009). Wyatt-Smith and Gunn (2009) have used a critical inquiry theoretical framework to guide the Australian teachers to reflect upon their conceptions of assessment. During professional learning community meetings, teachers are actively engaged in critical reflections and professional conversations about task complexity and knowledge demands through the application of assessment criteria and standards. A set of reflective questions are found to be useful for enabling teachers to consider the features of quality assessment: (1) alignment with curriculum; (2) intellectual challenges and engagement; (3) assessment scope and demand; (4) language used to communicate the task; (5) literate capabilities involved in doing and completing task; (6) performance contexts; (7) knowing what is expected both during and on completion of the task; (8) student self-assessment for improvement; and (9) intended purposes of assessment information.

We intend to answer the following research questions:

1. How do teachers benefit from a critical inquiry approach to conceptualize authentic assessment and assessment for learning (AfL) in the context of professional learning community?

2. To what extent does teachers' engagement in assessment task design contribute to their conceptions of authentic assessment and AfL?

3. To what extent does teachers' engagement in assessment task design contribute to the quality of assessment tasks and associated students' work?

4. How do students feel about authentic assessment in their learning of mathematics?

DESIGNING AUTHENTIC ASSESSMENT TASKS

During the first PLC meeting, the five teachers including the lead teacher were involved in critical inquiry of their conceptions of authentic assessment and AfL. They were also involved in analyzing the quality of assessment tasks and associated student work samples using two sets of criteria for authentic intellectual quality (AIQ) (Koh, 2011; Koh & Luke, 2009; Newmann, Marks, & Gamoran, 1996). This activity has enabled the teachers to internalize the criteria for AIQ and the features of authentic assessment. Using the design principles of authentic assessment, the criteria for AIQ, the Patchwork Text Assessment strategy, and the Structure of the Observed Learning Outcome (SOLO) taxonomy, the teachers co-designed mathematics performance-based tasks for the geometry (i.e., shape, space, and angle) unit of work. The patchwork text assessment strategy enables the mapping of the assessment tasks in the geometry unit to the specific instructional objectives across five different levels of the SOLO taxonomy: pre-structural, uni-structural, multi-structural, relational, and extended abstract. In short, the mathematics assessment tasks provide students with opportunities to engage in mathematical reasoning and critical thinking, application of mathematical concepts to solve real-world problems, extended communication, collaboration, generation of new knowledge, and making connections to other subject areas. The patchwork text assessment strategy has also enabled the teachers to scaffold students' learning of

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mathematics using quality feedback across a series of assessment tasks, which vary in their levels of cognitive complexity and intellectual challenge.

The mathematics assessment tasks are currently implemented at the Grade 6 classrooms. After the implementation of the assessment tasks in classrooms, the participating teachers will also be trained to judge the quality of student work samples in relation to the assessment tasks. This will allow the participating teachers to make meaningful linkages between quality task design and student learning outcomes. In addition, a focus group will be conducted with the participating teachers to probe into their conceptions of authentic assessment and AfL. A selected group of students will be interviewed for their experiences in completing the authentic assessment tasks.

INITIAL FINDINGS: BENEFITS AND CHALLENGES

The assessment literature has shown that an understanding of teachers' conceptions of assessment in the context of professional development is of paramount importance as professional development per se will not lead to a direct change in teachers' classroom practices (Guskey, 2002). The clarification of concept of formative assessment has been a significant feature of Black, Harrison, Lee, Marshall, and Wiliam's (2003) work with the UK teachers in assessment for learning. Teachers' misconceptions or misinterpretations of formative assessment may have adverse effects on their classroom practices, which in turn lead to negative students' learning outcomes. One notable example is Singaporean teachers' misconceptions of 'bite-sized' forms of assessment in the PERI reform that lead to their adoptions of frequent topical tests. According to Klenowski (cited in Koh & Luke 2009), there is a possibility that this form of assessment could encourage performance-orientated learning to the detriment of sustained and real learning. Teachers' limited conceptions of and confidence in assessment can restrict implementation of curricula designed to achieve more ambitious learning goals.

Some of our preliminary findings have shown that the rich professional conversations over the features of high-quality assessment tasks, the criteria for AIQ, and the identification of specific instructional objectives using the SOLO taxonomy have shed light on the teachers' understanding of authentic assessment and AfL. This has also led to their collaborative effort to co-design authentic assessment tasks or performance-based tasks for the Geometry unit of work. Our findings have shown that professional development that aims to improve teachers' assessment literacy needs to consider their conceptions of authentic assessment and AfL in addition to enhancing their skills in quality assessment task design. The latter will not only help teachers to improve the quality of classroom assessment tasks but also enable them to gain a better conception of authentic assessment and AfL. Teachers' critical inquiry and analysis of assessment task features and quality using the criteria of AIQ are found to develop their 'designers' eyes' so that they are competent to select, adapt, and design assessment tasks that promote students' learning of mathematics and the essential 21st-century competencies.

Despite our collaborative effort in the redesign of the mathematics assessment tasks, we are challenged by a busy teaching schedule and an existing reporting format in our school's rubric. Given that the benefits of co-designing mathematics authentic assessment tasks far outweigh the aforementioned challenges, we aim to sustain our school-based PLC through a negotiation with the school administrators in terms of allowing the teachers to have 'white space' so that PLC meetings can be held within the normal school hours.

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REFERENCES

Alberta Assessment Consortium. (2013). *Performance assessments*. Alberta. Retrieved from

http://www.aac.ab.ca/PerformanceAssessments.html

Alberta Education (2011). *Framework for student learning: Competencies for engaged thinkers

and ethical citizens with an entrepreneurial spirit*. Alberta. Retrieved from

http://globeclassroom.ca/userfiles/Alberta_Framework.pdf

Black, P., Harrison, C., Lee, C., Marshall, B., & Wiliam, D. (2003). *Assessment for learning:

Putting it into practice*. Buckingham, UK: Open University Press.

DeLuca, C., & Klinger, D. A. (2010). Assessment literacy development: Identifying gaps in

teacher candidates' learning. *Assessment in Education: Principles, Policy & Practice, 17*(4),

419-438.

Guskey, T. R. (2002). Professional development and teacher change. *Teachers & Teaching, 8*(3/4),

381-391.

Hattie, J. (2003). *Teachers make a difference: What is the research evidence?* Paper presented at

the Australian Council for Educational Research Annual Conference on Building Teacher

Quality. Melbourne, Australia.

Hattie, J., & Timperley, H. (2007). The power of feedback. *Review of Educational Research, 77*,

81-112.

Koh, K. (2011). Improving teachers' assessment literacy through professional development.

Teaching Education, 22(3), 255-276.

Koh, K., & Luke, A. (2009). Authentic and conventional assessment in Singapore schools: An

empirical study of teacher assignments and student work. *Assessment in Education: Principles,

Policy & Practice, 16*(3), 291-318.

McMunn, N., McColskey, W., & Butler, S. (2004). Building teacher capacity in classroom assessment to improve student learning. *International Journal of Educational Policy, Research, & Practice, 4*(4), 25-28.

Newmann, F, M., Marks, H. M., & Gamoran, A. (1996). Authentic pedagogy and student performance. *American Journal of Education, 104*, 280-312.

Sato, M., Wei, R. C., & Darling-Hammond, L. (2008). Improving teachers' assessment practices through professional development: The case of National Board Certification. *American Educational Research Journal, 45*(3), 669-700.

Sadler, R. (1998).Formative assessment: Revisiting the territory. *Assessment in Education: Principles, Policy & Practice, 5*, 77-84.

Stiggins, R. J. (2002). Assessment crisis: The absence of assessment for learning. *Phi Delta Kappan, 83*(10), 758-765.

Wiggins, G. (1989). A true test: Toward more authentic and equitable assessment. *Phi Delta Kappan, 70*(9), 703-713.

IT'S NOT JUST A BOOK CLUB: A NOVEL APPROACH TO PREPARE RESEARCHERS FOR PRACTICE

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A diverse group of researchers faced the challenge of developing practical proficiency in using Universal Design for Learning (UDL). In order to address the problem, the group initiated a book club strategy to develop a common understanding of principles of UDL. Their book club supported collaborative and reflective discussions, which informed their practice. In this paper, we share our lived experiences with book club as a professional learning strategy. Out of this experience, three recommendations are offered: intentional selection of the book, shared facilitation in support of a community of practice, and fostering collaborative professional learning.

Keywords: Book club; Universal design for learning; Field experiences

INTRODUCTION

A challenge when working with a diverse group of researchers can be the lack of a common understanding or common experience with a given topic. What is required is to provide a common lived experience where individuals are given the opportunity to learn more of the work within a learning community context. One such experience occurred with a diverse group of researchers challenged with developing proficiency in the use of Universal Design for Learning (UDL) in order to

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design and develop a blended learning environment. A book club approach as a professional development strategy was used which fostered active, collaborative discussions and scholarly exploration of the topic. This was the catalyst that helped form a community of practice among members of the group.

The purpose of this article is threefold: First, to provide an overview of how a book club strategy can be implemented to foster scholarly discourse and provide members a common experience to inform their understanding of the topic; second, to share our experience of using a book club and what we have learned from the experience; and third, to present three recommendations for the purpose of using of a book club strategy in support of preparing researchers for practice.

BOOK CLUBS

Book clubs are a unique social learning approach that allows for individuals to engage with content in traditional face-to-face settings and/or virtual environments (Sedo, 2003). Consisting of "small, peer-led reading discussion group[s]" (Daniels, 2002, p. 1), book clubs appear under a variety of names such as literature circles, cooperative book discussion groups, reading clubs and literature discussion groups (Daniels, 2002; Penson, 2011). As outlined in this paper, the implementation of a book club can promote a community of practice through collaboration, personal meaning-making through reflective discourse, and the development of self-efficacy in learning.

General context of a book club

During a book club discourse, individuals engage in thoughtful dialogue that allows the reader to construct reflective experiences based on his/her personal interactions with the text. Specifically, Long (2003) described the process of book clubs as "conversations [that] allow participants to clarify their own insights and opinions and also to integrate the various perspectives other readers bring to the book" (p. 187). As the reader shares his/her thoughts, a more meaningful frame of understanding is developed and the knowledge

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community is increased and interpretations are made through social interactions (McMahon & Raphael, 1997).

Book club is "not a spontaneous activity" (Daniels, 2002, p. 80). Rather, it is activities that are regularly structured through agreed upon methods for sharing personal reflections. To effectively contribute to the cohort's knowledge building, each book club is set up to engage the specific age and learning levels of the members. While these structures can be framed in a variety of ways, they are viewed as "long-term investments" (Daniels, 2002, p. 81) for learning.

From the research, seven commonalities have been identified among book clubs that assist students in achieving learning outcomes. Included in the commonalities are: 1) structured roles for members (i.e. each participant is given a specific role to help support peer discussion); 2) use of collaborative models; 3) development of self-efficacy through social interaction; 4) participant involvement based on book choice; 5) regularly scheduled meeting times; 6) discussion is through meaningful, open conversation and personal reflection; and 7) social constructivist frameworks (Chia-Hui, 2004; Daniels, 2002; McMahon & Raphael, 1997; Guthrie & Wigfield, 1997). Further in a higher education setting, book clubs are used to develop personal meaning through "co-constructed conversations" (Addington, 2001, p. 213) at varying levels including pre-service teachers with young students, undergraduate and graduate students as well as among professorial roles.

THE BOOK CLUB

The purpose of a design-based research was to develop an online learning environment for undergraduate Field Experience courses using Universal Design for Learning principles. Early in the design process, we discovered that there were varying understandings and a diverse range of experience using UDL. In order for the research team to do well in the design of the online environments, we engaged in professional learning experience for the purpose of developing a shared understanding through the use of a book club strategy.

 In our book club, all participants had a leadership role by summarizing his/her assigned chapter and leading the bi-weekly group discussion. That happened over the course of several weeks, at the beginning of the project. Although each team member was responsible for leading each session, there were some common steps in each session. After some general introductory announcements, the session leader would introduce the topic being debated for some 5 to 7 minutes. After that period, a conversation would emerge about key points of the book that resonated with each one of the team member. This process was facilitated by questions crafted by the session leader, or spontaneously by the group members. During the conversation, a constant focus was on how to transfer the collective knowledge created by the group into concrete actions and measures for the design project. After each session, the leader shared their notes with all members. This continuous repository of notes on UDL was crucial for the design process for the project, as it allowed quick access to relevant information about the framework.

One powerful aspect of our book club strategy was that all group members had similar responsibilities. In contrast, in other book club groups, the discussions can easily be "guided" narrowly by the leader and his / her agenda. Our book club context allowed us to collaborate through presenting our perspectives, negotiating our ideas, and resolving our misunderstandings. Moreover, it provided an opportunity for us to go beyond the idea of understanding the content, so to explore the innovative teaching and learning ideas that we wanted to implement in our research project.

RESEARCH DESIGN

Our reading group of six researchers (four doctoral students and two academic staff) met on a regular basis within a three-month timeframe. We had two key aims: First, to acquire a deeper collective understanding of UDL. Second, to apply that UDL knowledge in the design of the online learning environment for the research project. "Applied research is frequently descriptive research and its main strength is its immediate practical use" (Neuman, 1997, p.33). It is a form of research directly connected to the improvement of organizational practices and problems. Action research, a category of applied research, is aimed at solving a specific problem by engaging a group of individuals in an organization to study a problem in order to

solve it (Patton, 2002). Action research is self-reflective and thus promotes an understanding of the groups' own practices and the situations in which the practices are carried out (Carr & Kemmis, 1986, p.162).

Action researchers should seek the views of others as to the meaning of the data they have (Carr & Kammis, 1986). During our book club meetings, we were able to bring our personal insights and experiences into the discussion and shape the collective understanding that emerged from our conversations, which can be viewed as a form of collective self-reflection. The reflective accounts of our book club meetings were summarized by one individual each week and shared among the group. These written accounts formed the basis of our information gathering on UDL and allowed us to build a better informed plan for the design and development of the research project.

REFLECTING ON OUR EXPERIENCE

Aside from the specific knowledge we gained about UDL and the potential ways we can apply the principles of UDL in our work, three critical themes emerged from the collective reflections and shared discussions from our book club. Each will be discussed in the following section: 1) communication and collaboration; 2) meaning-making; and 3) self-efficacy.

Community and collaboration

The importance of collaboration and the shift towards community was an essential characteristic of our book club. Each participant commented in their reflections on this aspect of the experience. One student mentioned: "*I believe the strength of our discussions came from the collaborative nature of our group – we were able to build on each other's ideas and provide possible examples as related to our upcoming course re-design*" (S1). With reading being a primarily interpretive response by each individual (Childress & Friedkin, 2012), the sharing of one's reading experience and reflections (i.e. individual engagement) allows for other participants to encounter affirming or challenging ideas to their own personal reflections (Guthrie & Wigfield, 1997). Through the process of collaborative discourse, the book club provided a framework for participants to critically examine ideas and thoughts in an open environment that is poised for community building and active participation (McMahon & Raphael, 1997).

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From the practice of collaboration, a sense of community also grew. "*I realized that as a learning community, we came to know more about each other and the variety of perspectives each of us held. Our discussions gave us the opportunity to learn from each other and to work towards developing common insights about UDL*" (AS1). This was also evidenced by Smith (1996), who found that faculty book club participants expressed enjoyment from learning through their colleagues' previous experiences, appreciated the equality demonstrated among its members and the "spirit of cooperation" (p. 184) displayed by the non-disruptive conversations among members.

Meaning-making

All group members expressed the way in which their understanding of UDL had deepened because of the book club experience. One participant noted that "*we were given an opportunity not only to share a different perspective on one topic, but also brainstorm and explore innovative teaching and learning ideas*" (S2). Another participant stated that the "*book club went beyond the idea of understanding the content; we actually discussed how the content would be implemented in our project*" (S3). Described by Raphael, Kehus and Damphousse (2001) as "ownership" (p. 22), a book club allows for participants to be active in their attainment of meaning initiated through the collaborative discourse and reflective activities. Sometimes presented through critical incident of learning (i.e. ah-aha moment), during and after the scheduled meeting times or in more formal written responses, individual ownership of understanding emerged. The development of the ownership is part of the complexity of a meaningful learning process.

Self-efficacy

Most group members expressed a shift in their understanding of UDL. As noted by one member, initially "*UDL was a framework used solely towards assistive learning … Because it was something distant from my reality, I had never understood its intricacies and possible applications. Nevertheless, this has changed with the book club.*" (S4) Addressing the impact of book club on participants, Schrunk and Zimmerman (1997) suggested that the complex process of sense-making also involves self-evaluation which in turn influences motivation and overall self-efficacy.

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One member concluded that the knowledge constructed by individuals and the group through book club would transform their instructional design practice. "*Through our upcoming work, we now are going to put theory into practice. It is not a matter of just talking, but now it is about action*" (AS2). Knowledge to practice and practice informed by knowledge were practical goals of our book club learning community. As Daniels (2002) stated, a book club allows learners to "go through a developmental process of problem-solving, adjusting and fine-tuning" (p. ix).

RECOMMENDATIONS

Drawing on the literature and our experiences, the following three recommendations are designed to support the use of book clubs as part of preparing researchers for practice. First, the selection of a book needs to provide a large enough scope so all members find an area of interest or something of value. It can foster ownership of their professional learning by allowing individuals to select the chapter(s) or section(s) they want to lead and/or facilitate discussion with the group. Second, through the intentional shared facilitation of discussion of the book, it sows the seeds for the emergence of a community of practice. Through the interactions and commitment to learning through the use of book club, participants begin to influence each other's learning within the community. Third, using a book club strategy embedded in a community of practice allows individuals to investigate, reflect, discuss and collaborate. Such engagement in collaborative professional learning may lead to a shift in thinking and broadening perspectives that otherwise cannot be achieved by an individual's reading of the book alone.

CONCLUSION

Our purpose for using a book club approach was to develop our proficiency in the use of UDL, given the diversity of our knowledge and experience with this framework. Throughout the book club experience, we were able to present our perspectives, negotiate ideas, and resolve misconceptions that enabled us to have a greater common understanding of UDL. The book club was a starting point for our collaborative team, which quickly evolved into a community of practice. The initial building of self-efficacy as individuals strengthened the outcomes of the collaborative interactions during the scholarly book club discussions.

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From our book club experience, two main learning outcomes emerged. First, identifying and discussing our assumptions and our experiences through book club led to a deeper understanding and ability to make practical inferences. Second, sharing the leadership role among participants allowed for increased reflection and development of each member's understandings of UDL. The book club provided us with an opportunity to have a shared experience of reading, discussing and establishing new collective understandings, which created a foundation to inform our research project.

REFERENCES

Addington, A. H. (2001). Talking about literature in university book club and seminar settings. *Research in the Teaching of English, 36*(2): 212-248. http://www.jstor.org/stable/40171537

Carr, W., & Kemmis, S. (1986). *Becoming critical. Education, knowledge and action research*. Lewes: Falmer Press.

Chia-Hui, L. (2004). Literature circles. *Teacher Librarian, 31*(3): 23-25.

Childress, C. C., & Friedkin, N. E. (2012). Cultural reception and production: the social construction of meaning in book clubs. *American Sociological Review, 77*(1): 45-68.

Daniels, H. (2002). *Literature circles: voice and choice in book clubs and reading groups* (2nd ed). Portland, Me.; Markham, ON: Stenhouse Publishers; Pembroke Publishers.

Guthrie, J. T., & Wigfield, A. (1997). *Reading engagement: motivating readers through integrated instruction*. Newark, Del.: International Reading Association.

Long, E. (2003). *Book clubs: Women and the uses of reading in everyday life*. Chicago: University of Chicago Press.

McMahon, S. I., & Raphael, T. (1997). *The book club connection: Literacy learning and classroom talk*. New York: Teachers College Press.

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Neuman, W. L. (1997). *Social research methods: Qualitative and quantitative approaches* (3rd ed.). Boston, MA: Allyn & Bacon.

Patton, M. Q. (2002). *Qualitative research & evaluation methods* (3rd ed.). London: Sage Publications

Penson, W. (2011, Fall). Using book clubs in higher education. *Hoekten International: A Journal of Medical Humanities*. Retrieved from http://www.hektoeninternational.org/index.php?option=com_ content&view=article&id=391

Raphael, T., Kehus, M., & Damphousse, K. (2001). *Book club for middle school*. Lawrence, MA: Small Planet Communications.

Schunk, D. H., & Zimmerman, B. (1997). Developing self-efficacious readers and writers: The role of social and self-regulatory processes. In J. T. Guthrie & A. Wigfield (Eds.) *Reading engagement: motivating readers through integrated instruction*. Newark, Del.: International Reading Association.

Sedo, D. R. (2003). Readers in reading groups an online survey of face-to-face and virtual book clubs. *Convergence: The International Journal of Research into New Media Technologies*, *9*(1), 66–90. doi:10.1177/135485650300900105

Smith, M. (1996). Conversations about literacy outside classrooms: How adults talk about books in their book clubs. *Journal of Adolescent & Adult Literacy, 40*(3):180-186.

LEARNING 21ST CENTURY SKILLS BY ENGAGING IN AN INFOGRAPHICS ASSIGNMENT

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Practicing teachers who have strengthened their own 21st century skills will be well positioned to guide their students in enhancing traits such as effective communication and critical thinking. This paper outlines an infographics assignment in a Master's level Education course, designed to enhance students' 21st century skills while applying an instructional design framework and developing technical skills. One student in the course stated that the assignment was a valuable learning experience that challenged her to think about how a message can be conveyed visually, improved her ability to critically analyse visual information and strengthened her visual literacy skills.

Keywords: Infographics; 21st century skills; Instructional design; Critical thinking

21ST CENTURY SKILLS

Twenty-first century skills is a broad term that refers to the knowledge, skills, and traits that are generally acknowledged to be critical for today's learners to possess in order to be successful in work and life (American Association of Colleges of Teacher Education and the Partnership for 21st Century Skills, 2010). Although there is no definitive list of 21st century skills, they are generally considered to include the following: 1) knowledge in core subjects such as language arts, math, and

science; 2) interdisciplinary understanding, such as global awareness and environmental literacy; 3) attributes such as critical thinking, collaboration, and innovation; 4) information, media and technology skills; and 5) life and career skills, including adaptability, productivity, initiative and leadership (American Association of Colleges of Teacher Education and the Partnership for 21st Century Skills, 2010). The idea that skills and attributes such as effective communication are critical is not a new one; however, there is increasing acceptance that as a society we should be developing our learners to have a broader base than factual knowledge so that they can be successful in their careers and other aspects of life (Rotherham & Willingham, 2010).

Teachers can benefit from having some background in and opportunities to practice the sort of learning experiences that promote 21st century skills in order to implement such activities in their own classrooms. Not only should they have some technical skills in using digital tools, but they also need to develop attributes such as critical and innovative thinking, problem solving, and digital citizenship, in order to model 21st century skills for their learners (Smith & Dobson, 2011).

METHODS

This paper describes an assignment used in a higher education course for Master's level Education students, in which they created an infographic as a means to enhance their visual literacy, digital media, and instructional design skills. The insights and arguments presented in the paper represent those of the instructor and one of the students in the course.

INFOGRAPHICS ASSIGNMENT

The assignment was one of three assignments that students completed in an online Master's level course. All students in the course had a Bachelor's degree, and almost all of them were teachers in

K-12, higher education, or a continuing education context. Each student created his or her own infographic to use within their own professional practice.

An infographic is an arrangement of text and images such as drawings and charts, combined with the use of color and white space to convey information visually. This visual representation of concepts and data can potentially help the viewer to grasp information more readily (Janalta Interactive Inc, 2014). Although infographics are not new, in recent years they are being used more frequently in educational contexts to convey messages, relate numerical data, illustrate important concepts, and promote visual literacy skills in learners (Krauss, 2012).

There were three major learning outcomes associated with the assignment. First and most importantly, the instructor wanted students to think critically about different ways of conveying information, including graphs and charts, narratives and descriptions, icons and images; a related goal was to prompt students to think about how those elements are arranged, such as use of color and white space, text boxes, arrows, font sizes and placement of text, in ways that highlight certain points. The second learning outcome was for students to use an instructional design framework to guide the process, thereby putting theory into practice. A third learning outcome was for students to learn some digital media skills that they could use in their own work context to create educational materials for their own learners in future. Throughout the process, students would enhance several 21st century skills, including critical thinking and problem solving, communication, collaboration, creativity and innovation, information literacy, media literacy, initiative and self-direction (American Association of Colleges of Teacher Education and the Partnership for 21st Century Skills, 2010).

Students submitted three items as part of the assignment. First, a proposal was submitted to the instructor for feedback only, not grades. In the proposal students outlined their topic and concept for the infographic. They also identified the type of infographic they wanted to create:

- Comparison: Compares two or more things.

- Flow chart: Branches allow the user to decide which path to follow.

- Timeline: Displays chronological information.

- Process: Sequential, with steps or stages.

- Image-based: Use a photo or graphic to help convey information.

- Data: Visualized using statistics, charts, graphs, numbers, etc.

- Narrative: Includes diverse content that is not all visual; may tell a story.

- Metaphor: Uses a metaphor to illustrate concepts (Adams, 2014)

- Combination: Uses two or more types of infographics

- Other: A type of infographic that is not listed above

The final submission consisted of two items, the infographic and accompanying documentation. Students used the software Piktochart™ to create their projects, which allowed them to save their infographics as Word™ or PDF files. Documentation included a description of the intended learners for the infographic, learning outcomes, content and design decisions, and a reflection on the project. The timeline for the project was about a month, which allowed students to incorporate feedback from their proposals into their projects.

A grading rubric was given to students at the start of the assignment so they could see how their work would be assessed as they made progress on their projects. Two-thirds of the grade was allotted to the infographic, and one-third to the documentation. The infographic was assessed on factors such as success in conveying a clear focus and visual concept, use of text and graphics, and attention to detail. The documentation was assessed on the quality of the stated learning outcome for the infographic, articulation of audience, content, and design decisions, as well as a reflective statement on pedagogical issues regarding the creation and use of infographics. The intent was to have students think beyond cosmetic features of their assignment, to consider how their project enhanced learning of their intended audience. Therefore, part of the assessment was designed to encourage students to use 21st century skills.

STUDENT LEARNING

Students created some amazing infographics that they were able to implement in their professional practice, a positive benefit of the assignment (please see some examples of student projects at http://ederprojects.weebly.com/infographics.html). More importantly, though, was what they learned from the assignment. One student reflected on how teaching and learning with digital content could take multiple skills and good understanding of the pedagogical aspect of the instructional and graphic design. It is a complex process that involves careful planning and artistic execution. The infographic assignment gave students a unique experience in enhancing their 21st century skills from the perspectives of both being a student in the MEd program and being an educator who designed and produced an infographic for practical professional purpose. Through this infographic assignment, the student realized that, like any instructional design project, it is critical to have a thorough understanding of the learner profile and clear focus on the learning

outcomes. The development of 21st century skills such as critical thinking, problem solving, creativity, and media literacy was encouraged and enhanced throughout the project (American Association of Colleges of Teacher Education and the Partnership for 21st Century Skills, 2010). The student also reaffirmed that, as an educator, it is a good investment to spend time at the beginning of a project to understand the purpose and learners in order to effectively translate course content into digital formats.

With the infographic assignment, students had the opportunities to receive feedback from the instructor in various stages. Students started with a one-page proposal that outlined the target audience, topic, intended learning outcomes, type of infographic, and relevance to learners. This exercise was crucial in helping students define the project scope in an early stage. The expectations were clearly communicated by the instructor. Students were offered valuable resources and support and resources throughout the self-directed learning process.

One student who had no formal training in graphic design found that creating infographics for digital learning content was in itself not difficult. With readily available templates in Piktochart™, as well as flexibility to use more sophisticated features, students could quickly generate and publish infographics. However, creating a great infographic which conveys the information and messages clearly, concisely, and artistically, was more challenging. Students were asked to make many design decisions requiring close attention to very fine details. It takes a thoughtful mind with critical eyes to create an infographic that is right for the audience, with the right amount of information, and delivered in the right way. This student felt the infographics project helped her to gain valuable experiences and skills, opening a door to step into a world of possibilities of enhancing teaching and learning with interesting digital objects.

INFOGRAPHICS AND 21ST CENTURY SKILLS

Like the students in Matrix and Hodson's (2014) study of higher education students, the assignment promoted critical thinking skills, enhanced visual literacy, and required the learner to demonstrate innovation and self-direction. Young (2012) found that exercises in media literacy also enhanced junior high and high school students' traditional literacies, including writing for different audiences and writing clearly. Similar to the research, the student in this course felt that the assignment was successful in enhancing her 21st century skills. More research is needed to determine if the student's experience was typical of other students' learning in the course.

NEXT STEPS

As with most assignments, there is room for improvement in terms of enhancing the learning experience for students. In future it would be beneficial to add a peer review component to the assignment. Peer review offers a number of benefits, including gaining formative feedback before an assignment is graded, strengthening one's own work, and enhancing analytical skills (Cho & Cho, 2011; Li, Liu, & Steckelberg, 2010; Nicol, Thomson & Breslin, 2014). The timeline for the project would need to be lengthened by a week or two to allow for the peer review cycle but may be warranted considering the potential benefits to student learning. Additionally, it would be helpful to continue to build resources for the assignment. Future cohorts will be able to refer to examples of past students' work, to generate their own ideas and inspire them.

CONCLUSION

Through an infographics assignment, a Master's level student strengthened her 21st century skills such as critical thinking, visual literacy, and creativity. Rather than focusing on the cosmetics of

her project, she was encouraged to think about how information can be conveyed in a visual manner. Not only did she gain instructional design strategies and technical skills, she developed her own strategies for promoting 21st century skills. More research is needed in this area to determine the scope and impact of such assignments on student learning and engagement.

REFERENCES

Adams, D. (2014). *8 types of infographics and which one to use when*. Retrieved from

http://www.bitrebels.com/design/8-types-of-infographics-use-when/

American Association of Colleges of Teacher Education and the Partnership for 21st Century

Skills. (2010). *21st century knowledge and skills in educator preparation*. Retrieved from

http://www.p21.org/storage/documents/aacte_p21_whitepaper2010.pdf

Cho, Y. H., & Cho, K. (2011). Peer reviewers learn from giving comments. *Instructional Science:

An International Journal of the Learning Sciences*, *39*(5), 629-643. doi:

10.1007/s11251-010-9146-1

Janalta Interactive Inc. (2014). *Information graphic (infographic)*. Retrieved from

http://www.techopedia.com/definition/27808/information-graphic-infographic

Krauss, J. (2012). More than words can say: Infographics. *Learning and Leading with

Technology*, *39*(5), 10-14.

Li, L., Liu, X., & Steckelberg, A. L. (2010). Assessor or assessee: How student learning improves

by giving and receiving peer feedback. *British Journal of Educational Technology*, *41*(3),

525-536. doi: 10.1111/j.1467-8535.2009.00968.x

Matrix, S., & Hodson, J. (2014). Teaching with infographics: Practicing new digital

competencies and visual literacies. *Journal of Pedagogic Development*, *4*(2). Retrieved

from http://www.beds.ac.uk/jpd/volume-4-issue-2/teaching-with-infographics

Nicol, D., Thomson, A., & Breslin, C. (2014). Rethinking feedback practices in higher education: A peer review perspective. *Assessment & Evaluation in Higher Education, 39*(1), 102-122. doi: 10.1080/02602938.2013.795518

Rotherham, A. J., & Willingham, D. T. (2010). 21st century skills: Not new, but a worthy challenge. *American Educator, 34*(1), 17-20.

Smith, J. J., & Dobson, E. (2011). Beyond the book: Using web 2.0 tools to develop 21st century literacies. *Computers in the Schools, 28*(4), 316-327. doi: 10.1080/07380569.2011.620939

Young, S. J. (2012). Linking learning: Connecting traditional and media literacies in 21st century learning. *Journal of Media Literacy Education, 4*(1), 70-81.

MODELING CO-TEACHING TO INFORM PROFESSIONAL PRACTICE

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Co-teaching in higher education provides an environment conducive to developing leadership capacity in undergraduate nursing students. A mixed method research design was developed to explore how the complexity of the co-teaching experience influences leadership development of nursing students enrolled in the 'Nurse as Educator' course. The inquiry was guided by the question, what impact does co-teaching in a nurse education course have on the development of leadership in professional practice? Initial findings from the first of research are shared in relation to examining attributes of co-teaching, strengths and challenges, as well as how the experience of co-teaching has influenced student understanding of leadership in professional practice.

Keywords: Co-teaching; Professional practice; Leadership

INTRODUCTION

The scholarship of co-teaching in higher education is discussed, considering the advantages and the qualities that inform its teaching practice. An examination of the complexity of the co-teaching experience is shared, along with how this influences student understanding of leadership in professional practice. From an ongoing two-year research study, initial findings in relation to co-teaching, transformational leadership, and professional practice development are discussed.

Review of the literature

Co-teaching in higher education is defined as "two or more individuals who come together in a collaborative relationship for the purpose of shared work….for the outcome of achieving what none could have done alone" (Wenzlaff et al., 2002, p.14). This collaborative relationship creates new opportunities for different ways to engage in curriculum design, planning, and teaching. Co-teaching supports the potential of a strong learning community for students and instructors both pedagogically and professionally (Ferguson & Wilson, 2011).

Co-teaching is complex. Rytivaara and Kershner (2012) noted that co-teaching is "a genuinely peer-learning relationship in which communication shifts between different contexts within and beyond the classroom" (p. 1001). In the creation of the relationship there needs to be intentionality and purposefulness. Laughlin, Nelson, and Donaldson (2011) argued that co-teaching is more than pairing instructors together or teaching in a sequential fashion. Rather they posit that the success of co-teaching requires "careful preparation" (p. 12). It cannot be assumed that co-teaching or team teaching relationships occur naturally or evolve in a healthy manner. According to Yanamandram and Noble (2005), successful co-teaching collaboration requires an investment of time and effort. Drawing from Laughlin et al.'s (2011) work, the following should be considered in advance of engaging in co-teaching:

1) Discussing benefits of the approach for co-teachers and their professional community;

2) Defining partners' roles, exploring expectations to support consistent practice;

3) Negotiating effective pedagogical approaches for specific content and context;

4) Establishing strategies to manage challenges and conflicts; and

5) Cultivating an understanding of co-teaching in higher education.

As such, it is important to remember the co-teaching relationship is dynamic and that co-instructors need to be responsive to external stimuli and not assume what worked before will work again. Co-teaching involves a complex relationship that requires intentionality in learning to react and respond to each other and to the class. The scholarship of co-teaching reveals essential qualities that are required to develop and to sustain a healthy, effective co-teaching relationship.

Advantages of co-teaching in higher education

Co-teaching involves "messiness" (Plank, 2011, p. 2) that "moves beyond the familiar and predictable and creates an environment of uncertainty, dialogue, and discovery" (Plank, 2011, p. 3). Bacharach, Heck and Dahlberg (2008) reported that the co-teaching experience supported the utilization of different teaching strategies, allowed the pairs to be more reflective with regard to their teaching given they negotiate decisions with each other, helped to enhance their teaching practice, and "provided an energizing opportunity for faculty to renew their passion for their profession" (p. 15).

Co-teaching provides an opportunity for the instructors to model effective practices of this approach to teaching to their students. According to Harris and Harvey (2000), co-teaching "provides the opportunity to model different ways of teaching and responding to conflict in the classroom" (p. 90). From Stang and Lyons' (2008) research with pre-service teachers, all students in their study "reported that the act of observing faculty co-teach was the most valuable learning tool" (p. 191). Yanamandram and Noble (2005) examined student experiences and perceptions of co-teaching and their findings revealed that students' motivation and interest in the subject were fostered as a result of being co-taught. In addition, they experienced an enhanced learning environment that helped them to deal with different situations and consider the validity of

numerous views. Further, Plank (2011) argued that students observing "their teachers learn from each other and even disagree with each other models for students how scholars and informed citizens within a community of learning can navigate a complex and uncertain world" (p. 5). This modeling within the formal learning environment helps students to appreciate the nature of the collaboration required of them in their professional workplace settings.

Relationship between co-teaching and transformational leadership

Heller et al. (2004) suggested that generally, nurses are not adequately prepared for the role of leader during their nursing education. Evidence supports the use of transformational leadership as an effective framework for advancing nursing leadership and the notion that leadership in nurses can be developed through educational activities, modeling and practicing leadership. Further, those opportunities to observe leadership skills lead to great self-efficacy in nurses' leadership behaviours (Curtis, De Vries, & Sheerin, 2011b).

Transformational leadership is described as a leadership style that aims to inspire others to develop and use effective leadership characteristics (Burns, 1978). Transformational leadership has been characterized as challenging the process, modelling the way, sharing a bond with and inspiring followers, and being able to empower others through a shared vision and trust (Curtis et al., 2011a; Kouzes & Posner, 1995, 2002). DeSimone (1996) described transformational leaders as change agents who believe in people and can deal with complexity and uncertainty. This leadership requires an appreciation for being dynamic and responsive to complexity and uncertainty; it involves a relationship and the notion of mutuality, having a shared vision, and trust. Adopting a transformational leadership style is vital for nurses since it encourages change and allows for the recognition of areas in which change is needed (Pickerill, 2014). All of these qualities identified

relative to transformational leadership are also embodied within an effective co-teaching collaboration.

Several studies provide evidence of how co-teaching influences the development of nurses' leadership in professional practice. It was found that when students were taught by more than one instructor in a communication skills course that the teachers acted as professional role models (Minardi & Riley, 1991). Mislang (2011) found that nursing students responded positively to being co-taught; specifically noting that it challenged and promoted their learning and increased teacher credibility as they acted as nursing role models. Dumas (1999) in a Canadian study concluded that the strategy of co-teaching prepares nursing students to face different perspectives in professional values and it expands their knowledge base. From such studies, it is evident that further inquiry is needed to examine how the experience of co-teaching influences student understanding of leadership in professional practice.

RESEARCH DESIGN

The first of a three-phase mixed method research was conducted in fall 2014. The purpose of the study was to explore the influence of co-teaching on the development of leadership in professional practice, and to investigate the benefits and challenges of co-teaching in higher education. The following research question guided the study: What impact does co-teaching in a nurse education course have on the development of leadership in professional practice? Students enrolled in a *Nurse as Educator* course along with their instructors were invited to participate in the study.

For the purpose of this paper, the data shared is from the individual interviews with students (N= 4) and a focus group interview with instructors (N=2). In the interview, a series of questions engaged participants in exploring their experience with co-teaching and how it influenced student learning,

the qualities of co-teaching, the strengths and challenges of co-teaching, and how being co-taught influenced student practice and development as a leader. Thematic analysis of the interview data occurred.

DISCUSSION OF THE FINDINGS

From the student interviews, it was evident that they found value in their co-taught learning experience. The students appreciated the partnership that was modeled given the differences of backgrounds, experiences and areas of expertise of the instructors. They acknowledged such key attributes of learning in a co-taught environment as: 1) each instructor brings her own experiences and perspectives to the teaching; 2) instructors have a strong understanding of course outcomes; and 3) instructors are respectful and are supportive of student learning.

From their experiences with co-teaching both in this course and other courses, the students identified strengths of co-teaching, along with challenges. A strength that resonated was the importance of having more than one point of view to explore the content and experiences, a finding discovered in several other studies (Dumas, 1999; Floyd, 1975; Kerridge, Kyle, & Marks-Maran, 2009; Yanamandram & Noble, 2005). Students also identified challenges such as: the asynchrony between the instructors; the need to balance two different personalities; the impact of differing philosophical approaches to teaching; the potential to create confusion for students; and the issue of one instructor over shadowing the other in terms of leadership. Previous studies have also noted the challenges for students in instances of personality conflicts between instructors and/or where they contradict one another (Dumas, 1999; Floyd, 1975; Minardi & Riley, 1991).

They were asked how being co-taught has influenced their development as a leader. From their responses, four key ideas emerged. First, through the course experience students were developing

confidence in being leaders and were developing leadership skills. Second, they were able to establish where they are in terms of their leadership and to reflect on strengths and weaknesses. Third, there was the development of an appreciation that leadership can occur in groups or as a pair and not always alone. Fourth, they were gaining a greater understanding of the fluid nature of the leadership role. As noted by one student, "As an influence on me being a leader it definitely opens up my options on how I approach leadership in general."

The instructors revealed they had established a healthy co-teaching rapport and purposefully designed assignments that engaged students in developing their professional practice. The instructors also shared that they modelled effective co-teaching. This modeling of effective co-teaching provides students with an example of how to enter into professional relationships and manage differences in values and opinions while maintaining mutual respect and openness (Dumas, 1999; Mislang, 2011). When asked about the influence they had on the leadership capability of their students they noted the following qualities of co-teaching. First, co-instructors like good leaders need to know when to lead and when to follow. Second, there is an aspect of humility that needs to be in place in terms of being open to recognize one's limitations both in co-teaching and in leadership. Third, verbal and the non-verbal communication play a key role in co-teaching and in leadership. Fourth, the need for authenticity honouring who you are and the role you have, influences the co-teaching relationship as well as the leadership relationship. Fifth, there is a need for humour in the roles of co-teachers and leaders.

The instructors' shared the following key words and phrases which best capture the heart of co-teaching: 1) trust; 2) willingness to learn; 3) open to vulnerability; 4) authenticity; and 5) relationships. These attributes speak to the qualities associated with transformational leadership which requires an appreciation of the need to be dynamic and responsive to the complexity within

the classroom, and involves a relationship based on mutuality, having a shared vision, and establishing trust.

CONCLUSION

These initial findings indicate the impact of co-teaching on student learning. Further, it reveals how effective co-teaching practice role models the qualities associated with transformational leadership and enacting relationships in professional practice. What is less clear is how these students will transfer their co-teaching experience and translate an understanding of the qualities associated with effective co-teaching and transformational leadership to inform their own professional practice.

REFERENCES

Bacharach, N., Heck, T.W., & Dahlberg, K. (2008). Co-teaching in higher education. *Journal of College Teaching & Learning*, *5*(3), 9 – 16.

Burns, J. M. (1978). *Leadership*. New York: Harper & Row.

Curtis, E., De Vries, J., & Sheerin, F. (2011a). Developing leadership in nursing: exploring core factors. *British Journal of Nursing*, *20*(5), 306–309.

Curtis, E., De Vries, J., & Sheerin, F. (2011b) Developing leadership in nursing: the impact of education and training. *British Journal of Nursing*, *20*(6), 344-352.

DeSimone, B. B. (1996). Transforming curriculum for a nursing leadership course: a collaborative approach. *Journal of Professional Nursing 12* (2) 111-118.

Dumas, L. (1999). Quality perinatal nursing education through coteaching. *Journal of Perinatal Education*, *8*(4), 27-35.

Ferguson, J. & Wilson, J. C. (2011). The co-teaching professorship: Power and expertise in the co-taught higher education classroom. *Scholar-Practitioner Quarterly, 5*(1), 52-68. Retrieved from http://www.eric.ed.gov/PDFS/EJ942564.pdf.

Floyd, G. J. (1975). Team teaching: Advantages and disadvantages to the student. *Nursing Research, 24*(1), 52-56.

Harris, C. & Harvey, A. N. (2000). Team teaching in adult higher education classrooms: Toward collaborative knowledge construction. *New Directions for Adult and Continuing Education, 87,* 25-32.

Heller, B. R., Drenkard, K., Esposito-Herr, M. B., Romano, C., Tom, S., & Valentine N. (2004). Educating nurses for leadership roles. *Journal of Continuing Education in Nursing, 35*(5), 203-210.

Kerridge, J., Kyle, G., & Marks-Maran, D. (2009). Evaluation of the use of team teaching for delivering sensitive content-A pilot study. *Journal of Further and Higher Education, 33*(2), 93-103.

Kouzes, J. M., & Posner, B. Z. (1995). *The leadership challenge: how to keep getting extraordinary things done in organizations*. California: Jossey- Bass.

Kouzes, J. M., & Posner, B. J. (2002). *Leadership challenge* (3rd ed.). San Francisco: Jossey-Bass.

Laughlin, K., Nelson, P., & Donaldson, S. (2011). Successfully applying team teaching with adult learners. *Journal of Adult Education, 40*(1), 11 – 18.

Minardi, H. A., & Riley, M. J. (1991). The use of team teaching for communication skills training in nurse education. *Nurse Education Today (11),* 57 – 64.

Mislang, J. (2011). *The experiences of undergraduate nursing students enrolled in a team teaching curriculum*. Master's Thesis (retrieved from the Canadian Health Human Resources Network at http://www.hhr-rhs.ca/)

Pickerell, K. J. (2014). *A Transformational Leadership Program: A Necessity in Today's Healthcare Environment*. Graduate Theses, Dissertations, and Capstones. Paper 5.

Plank, K. M. (2011). Introduction. In K.M. Plank (Ed.), *Team Teaching: Across the Disciplines, Across the Academy* (pp. 1-12). Sterling, VA: Sylus.

Rytivaara, A., & Kershner, R. (2012). Co-teaching as a context for teachers' professional learning and joint knowledge construction. *Teaching and Teacher Education, 28*(7), 999-1008.

Stang, K. K., & Lyons, B. M. (2008). Effects of modeling collaborative teaching for pre-service teachers. *Teacher and Education Special Education, 31*(3), 182 – 194.

Wenzlaff, T., Berak, L. Wieseman, K., Monroe-Baillargeon, A. Bacharach, N., & Bradfield-

Kreider, P. (2002). Walking our talk as educators: Teaming as a best practice. In E. Guyton & J. Rainer (Eds.). *Research on Meeting and Using Standards in the Preparation of Teachers* (pp. 11-24). Dubuque, IA: Kendall-Hunt Publishing.

Yanamandram, V. K., & Noble, G. I. (2005). Team teaching: student reflections of its strengths and weaknesses. In R. Atkinson & J. Hobson (Eds.), *Teaching and Learning Forum: The Reflective Practitioner* (pp. 1-10). Australia: Murdoch University.

MICRO-CREDENTIALING: DIGITAL BADGES IN FACULTY PROFESSIONAL DEVELOPMENT

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Many instructors in higher education rely on non-credit professional development opportunities to enhance their teaching practice. Using digital badges as a form of micro-credentialing is one way that faculty and graduate students can plan, document, and share their non-credit learning and accomplishments. Micro-credentialing has the potential to allow people to set flexible and personalized learning goals, defining what professional learning opportunities are meaningful to them. This paper introduces digital badges and micro-credentialing, describes a platform for issuing and displaying badges, and introduces a pilot study on the impact of a digital badges program.

Keywords: Badges; Micro-credentialing; Professional development

INTRODUCTION

In this paper we will discuss digital badges as a form of micro-credentialing for professional learning development in higher education. We will introduce the University of Calgary's badge platform, and examine initiatives from three other institutions. This paper also outlines some of the major benefits of micro-credentialing for professional learning development, including the flexibility for individuals to plan their own personal learning pathway, making decisions about the selection and pacing of learning experiences.

WHAT ARE DIGITAL BADGES?

Similar to cloth badges earned by Boy Scouts and Girl Scouts, digital badges are icons that represent skills and achievements such as the completion of a project, the mastery of a skill, or the accumulation of experience (Bowen & Thomas, 2014; EDUCAUSE, 2012). Digital badges embed information about when, where and how they were earned. Such information, or metadata, includes the name of the issuer, the date issued, and the criteria for earning the badge. Badges provide a visual record of achievement, and can be stored or shared through social media tools, platforms or networks such as Mozilla Backpack™ or LinkedIn™. Badges may also be added to personal portfolios to allow users to demonstrate learning in ways other than a traditional credit courses and transcripts (EDUCAUSE, 2012).

Digital badges are a form of "micro-credentialing," which is a way to recognize competencies or skills, acquired through a variety of learning experiences, at a more granular level than is captured by conventional transcripts or degrees (Gamrat, Zimmerman, Dudek & Peck, 2014). Micro-credentialing allows people to document professional learning development attained through stand-alone (non-credit) workshops and seminars. The use of micro-credentialing enables faculty, staff, and graduate students to have more flexibility to select learning experiences and set their own personal learning pathway.

BENEFITS OF DIGITAL BADGES

Proponents of digital badges assert that they have two potential benefits: learner motivation and documenting accomplishments. First, they may motivate people to engage meaningfully with professional learning activities. Badges provide a small extrinsic form of reward for the accomplishment of learning goals. Such extrinsic rewards can have mixed influences on the

learning process for different people (Abramovich, Schunn, & Higashi, 2013), but they may be motivating to some individuals.

Second, digital badges can document informal and formal learning accomplishments achieved outside of credit programs in a more flexible way than traditional methods such as transcripts and paper certificates. According to EDUCAUSE Review (2013):

> [S]maller achievements can represent incremental learning and progress toward more significant goals. They can also recognize learning and skill building that is not part of, but enhances or complements, a formal degree program. As such, badges are becoming an increasingly popular way for universities to more fully document the breadth of student learning (p. 1).

In the context of professional learning development, digital badging represents a change in approach to how accomplishments are measured. Traditionally, professional learning development is measured by the amount of time spent in training (for example, number of hours). Digital badges represent a shift from attendance-based certificates to criteria-based accomplishments. In order to receive a badge, participants must meet a learning outcome or demonstrate their learning or new skills. In contrast to attendance or participation, a digital badge indicates that the learner has met some external criteria in order to receive it (EDUCAUSE, 2012).

SCHOLARLY EVIDENCE TO SUPPORT THE USE OF BADGES

There is scant academic research on using micro-credentialing in higher education at this time. Related literature includes a recent study that examined a digital badging system for teacher professional development (Gamrat et al., 2014). These researchers determined that micro-credentialing was valuable for participants by allowing them to set flexible and personalized

learning goals, define professional development opportunities that were personally meaningful, and manage their own pace (Gamrat et al., 2014).

McDaniel, Lindgren and Friskics (2012) studied university students' responses in a credit course that allowed them to choose their own learning pathway, with exams for each module and a digital badge upon completion. Results of the study showed that students had a positive impression of the course, particularly appreciated the opportunity to define what they would like to study. The achievement system (i.e., badges) had a moderately positive impact on students.

HOW OTHER INSTITUTIONS ARE USING DIGITAL BADGES

Digital badges are in use or in development at a number of higher education institutions in the United States (Pearson, 2013). Among universities experimenting with or implementing badges are Purdue University, Pennsylvania State, the University of Southern California, Indiana University, and the University of Illinois at Chicago. Purdue University is developing a "Passport app" to enable instructors to create badges for their students, and to enable those students to share them via social media and present them to prospective employers.

While many American universities have used badges as a means to recognize the skills and knowledge developed by students, some have integrated this approach to micro-credentialing into their professional development programs. At Indiana University, the Center for Innovative Teaching and Learning (CITL) has developed a three-tier micro-credentialing system for faculty members engaged with new learning technologies (Hart, 2015). The "basic-level badge" recognizes faculty members who have consulted with the CITL and developed a basic understanding of one or more learning technologies. The "proficient-level badge" recognizes faculty members who have implemented technologies in the classroom, and shared the results of

such implementation with others, while the "advanced-level badge" recognizes faculty members who have led broader implementation of new learning technologies, or shared their expertise beyond the institution.

At Texas Wesleyan University, the Center for Excellence in Teaching and Learning (CETL) developed a complex badging system that awards points for faculty members who attend or present workshops, visit the CETL office, or engage in professional development activities through social media (Hart, 2015). CETL created an online "leaderboard" enabling faculty members and staff to compare their professional development activities. According to Hart (2015), participation in CETL workshops by Texas Wesleyan faculty members more than doubled within six months, and over four-fifths of those who participated expressed support for the badging initiative.

UNIVERSITY OF CALGARY DIGITAL BADGE INITIATIVE

The Taylor Institute for Teaching and Learning of the University of Calgary offers numerous programs and initiatives for instructors and graduate students, aimed at improving the quality of teaching and thereby enhancing the student learning experience. As of March 2015, participants who completed one of two programs received a digital badge: the Course Design Program, and the Teaching Online Program (TOP). This pilot micro-credentialing program operates on an online platform (https://badges.ucalgary.ca/#/) created and maintained by the University of Calgary.

The Course Design Program is a hands-on workshop in which participants design a new course or modify an existing course. In order to earn the badge, participants are required to develop measurable course outcomes for their course, and plan effective teaching and learning activities and student assessment strategies that are aligned with the course outcomes.

The Teaching Online Program is a four-week, immersive program for instructors who want to begin or enhance their online teaching. Criteria for receiving a badge include facilitating an online asynchronous discussion, planning an online activity, creating an assessment blueprint, and completing a final task of their choice.

After receiving a badge, participants can display it on their UCalgary Badges profile, and print a summary of their accomplishments or a specific badge's criteria. They can also choose to export their badges earned at University of Calgary to Mozilla's OpenBadges Backpack™, where they can be pushed to social media accounts such as LinkedIn™. By collecting and displaying badges offered by various units and institutions, people can identify their own personal learning pathway and display their accomplishments to others.

RESEARCHING THE UCALGARY BADGES INITIATIVE

Over the next year, researchers will explore the impact of micro-credentialing within the context of the professional development of university teachers. Specifically, researchers will study the impact of micro-credentialing on learner motivation in educational development programs. Participants of the mixed methods design-based research study will be asked whether or not the badge was motivating to them, how they intend to use the badge, and their impressions of the badge's credibility. The goal of the study is to determine how effective digital badges are at rewarding and recognizing educational development learning achievements and outcomes. Through the study we will gain a better understanding of the role of badges in professional learning programs by systematically observing particilpants' motivation, program completion, perception of the badges, and desire to take other programs that offer badges. The resulting findings will be one step towards

filling the gaps that currently exist in the literature on micro-credentialing in professional learning development.

CONCLUSION

Micro-credentialing is an emerging method of documenting professional learning development in higher education. Many instructors enhance their teaching practice through workshops, seminars, and other non-credit programs; digital badging offers a flexible, personalized way for individuals to plan, document and share their accomplishments. Unlike traditional professional activities that require only a certain number of hours of attendance, digital badges are awarded for meeting some criteria or accomplishing something (EDUCAUSE, 2012). This paper outlined the digital badging system at the University of Calgary and the criteria that need to be met in order to receive a badge. A research study will determine the effectiveness of the initiative.

REFERENCES

Abramovich, S., Schunn, C. & Higashi, R. (2013). Are badges useful in education? It depends upon the type of badge and the expertise of learner. *Education Technology Research and Development*, *61*, 217-232.

Bowen, K. & Thomas A. (2014). Badges: A common currency for learning. *Change: The Magazine of Higher Learning*, *46*(1), 21-25.

EDUCAUSE. (2012). *7 things you should know about badges*. Retrieved from http://www.educause.edu/library/resources/7-things-you-should-know-about-badges

EDUCAUSE Review. (2013). *Digital badges for professional development*. Retrieved from http://www.educause.edu/ero/article/digital-badges-professional-development

Gamrat, C., Zimmerman, H. T., Dudek, J., & Peck, K. (2014). Personalized workplace learning: An exploratory study on digital badging within a teacher professional development program. *British Journal of Educational Technology, 45*(6), 1136-1148.

Gillespie, K. J., & Robertson, D. L. (2010). *A guide to faculty development* (2nd ed.). [Electronic version]. Jossey-Bass. Retrieved from

http://site.ebrary.com.ezproxy.lib.ucalgary.ca/lib/ucalgary/docDetail.action?docID=10371858

Hart, M. (2015). *Badges: A new measure of professional development*. Retrieved from http://campustechnology.com/Articles/2015/01/14/Badges-A-New-Measure-of-Professional-D evelopment.aspx?Page=2

McDaniel, R., Lindgren, R., & Friskics, J. (2012). *Using badges for shaping interactions in online learning environments*. Published in the Proceedings of the 2012 IEEE International Professional Communication Conference (p. 55-76), October 8 – 10, 2012.

Pearson (2013). *Acclaim: Open badges for higher education*. Retrieved from http://www.pearsoned.com/wp-content/uploads/2013/12/Open-Badges-for-Higher-Education. pdf

GAMEFUL SPACE, ACTIVITIES AND ASSESSMENT FOR GAME-BASED LEARNING

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This paper discusses the iterations of designing and implementing a graduate level course on digital game-based learning at a Western Canadian university. We critically analyze the design of the course by examining the tensions that arose between the course assessment and social practices common in playing games, and discuss activities introduced to mitigate such tension. We also consider how the use of the university library's space and resources in the second iteration provided new opportunities for the course. We explore on how "playable" the course has been and present our proposed improvements for the next iteration.

What I did find unique about the XP is where we chose avatars and did not know who each person was. I think this kind of thing works really well when the people in class already know most people, so it is fun to try and guess who is who… I was not having some conversations in class about certain topics because I didn't want people to find out who I was online.

Doc Claw, Reflection Paper

In 2013, the first author designed and implemented a master's course on game-based learning, which incorporate game concepts such as experience points (XPs) and multiple battles (Sheldon, 2011), in order to provide learners with an opportunity to explore the design of digital games, associated learning principles and their uses for teaching and learning (Kim, 2014). Incorporating

game principles into this particular course has important values in addition to the motivational aspects of game play. We posit that the teachers should be cognizant of how today's youth learn and develop. Young people are often engaged in what Thomas and Brown (2011) called, "a new culture of learning" in their social worlds by inventing and examining new ways of doing things, which is also embedded in their gaming practices. The first iteration in 2013 informed the authors to collaborate and improve many aspects of the course in 2014. For example, an avatar for XPs was introduced primarily to resolve the tension in sharing their scores (Kim, 2014) and secondarily to reframe the typical online discussion as a gaming experience (McGonigal, 2015; Ramirez & Squire, 2015). The excerpt from Doc Claw's (screen name of a student) reflection paper demonstrates that the new design comes with a new issue to be addressed. In this paper, we briefly describe the first iteration of the course, discuss how we redesigned and observed during the second iteration, and present what we propose for the third, upcoming iteration.

THE FIRST ITERATION OF THE COURSE DESIGN AND THE ISSUES RAISED

The course was intentionally positioned to allow the graduate learners to deconstruct their own learning, teaching and gaming experiences in relation to learning theories, the possibilities and constraints of game-based learning and to consider the use of both educational and commercial off-the-shelf (COTS) games in and out of classroom settings (Kim, 2014). Within a two-week intensive program, students participated as a community of learners and teachers both face-to-face and through a social networking system (Google+) to brainstorm, share, cumulate and trace evolving ideas and resources on game design and learning. The boss battle incorporated the written graduate course assignments while the mini battles included team building, sharing of project plans and developing a game design or prototype. The analogous boss battle in a video game denotes

fighting the most powerful enemy at the end of a game level, which requires players' use of various skills developed throughout the game play (Kim, 2014).

The learners were also encouraged to play games of their choice daily, write brief reviews, record their levels/progress and log their play time in order to attain the position of a super-gamer in the class. All of their online and in-class activities were part of important experience, thus reflected in their XPs, analogous to the participation grades (for more details on the structure of assessment, please refer to Kim, 2014). However, after the first day of the course, even though most of the activities were visible on Google +, sharing of XPs in class based on individual performance (as in visible numbers to account for their contribution/effort, analogous to leaderboard in video games) was not welcomed by students. The XPs eventually convert to graduate course grades, which are typically personal, and therefore joint decisions were made to keep the XPs private. The large amount of work for each day was also an issue, and the learners and the instructor made several joint decisions and amendments (e.g., expected number of game reviews). There was also mixed reaction to the course format. Assessments, particularly the breakdown of points and items for individual tasks, caused concern for some learners. This resulted in interpreting the point system as a course assessment rubric although the intention was to offer more choices to them (i.e., they do not need to complete all the items listed). Many students felt they would have enjoyed the course more had there been more time (than 2 weeks) for the course. Although the course was positioned as a game, the underlying premise of a university credit course does not entail infinite number of failures and repetition (Kim, 2014).

SECOND ITERATION OF THE COURSE DESIGN WITH MODIFICATIONS

The second iteration of the course in 2014 introduced new elements for the accumulation of XPs. Firstly, the learners could create avatars to maintain anonymity for their online activities and self-score their XPs daily for the leaderboard. Secondly, time was allocated to discuss and review daily activities of selected avatars on specific activities such as microblogging on game reviews and scoring conventions of XPs. This accommodated the element of immediate feedback often lacking in higher education. The self reporting of XPs as avatars was intended to accommodate privacy, eliminate the surprise of finding out scores from the instructor and encourage or foster learners' agency in assessing and monitoring their own performance.

The redesigned component also included use of space and the vast collection of digital games owned by the university's main library. This allowed the students to experience a variety of games and learn from peers with more experience in gaming. Having a gameplay time during the course also addressed the concern from the first iteration, where students felt overwhelmed by the various tasks to complete each day outside of the classroom. On account of these modifications the learners played games and participated in discussions to start off the session everyday. Similar to the first iteration, all of their learning activities accounted for the XPs, including sharing their groups' game design progress through microblogging on Google +. The three battles did not have any major change for the second iteration.

OBSERVATION AND RESULTS

For the summer of 2014 course, we gained consent from the majority of students for collecting diverse data (observation notes, classroom artifacts, assignments, and Google+ discussion) and using them for research purposes. The following account is our preliminary findings from the

observation. Fourteen out of fifteen students were from the same master's program cohort focusing on integrating technologies in school environment, and had worked together in their course work earlier. Their teaching experience varied and some were in their leadership roles. The setting of the class in the library was ideal for discussions and gameplay with six circular tables equipped with three computers. The library staff helped set up various gaming equipment and the space in between the two columns of tables and one side of the room were used for gaming purposes. Three walls of the room had white boards with a projection screen in front. Most sessions started with playing digital games except for the first day when an introductory game (paper-based) was played as an ice-breaker, and another day with a board game play.

Gameplay and co-reflection. From the beginning of the course, the in-class gameplay and discussion was found engaging and valuable. In the introductory game, for example, each player had to visually express (in any form) the answer to a question (framed by another player) provided at the back of a paper. The rest had to guess the answer. The player who had to act out or draw the clues could not utter a word. The questions were created by the players and were about themselves. The three teams (formed by the learners) were engaged in the game as well as the follow-up discussion: they were competitive, creative with strategies, and advocated for changing some rules to make the gameplay interesting and fair. The ensuing discussion brought out how they had to think outside the box to learn details about their classmates, which they would not have otherwise. Others noted how the strategies and the scoring system evolved during the game play and how they could self-monitor. The question that stood out however was what made them willing participants. The players felt that a game had to have certain criteria such as the ability to facilitate rapport, interest and a spirit of competition for everyone to enjoy the game. As the course progressed the learners played a wide variety of commercial (console and PC) games including classic games on

Intellivision, educational games, and social impact games. Time spent on games helped foster invaluable discussions around the reading topics.

Course structure and workload. Despite the effort to have more work embedded within the class time, in-between discussions especially towards the beginning of the course marked the surprise realization about the graduate level workload, similar to the first iteration. Some took the new rules and requirements as a new, interesting challenge whereas others found it overwhelming to read and write so much (i.e., the maximum repetition of activities were interpreted as requirements; see Figure 1) and the process of self-assessment confusing. The concept of a game leaderboard inevitably challenges the existing rules and structure of a graduate course. The discussions on the course structure, their assignments and assessment of tensions on account of the above, for multiple days, mitigated the stress, clarified the element of choice, and helped specify the guidelines together for their activities.
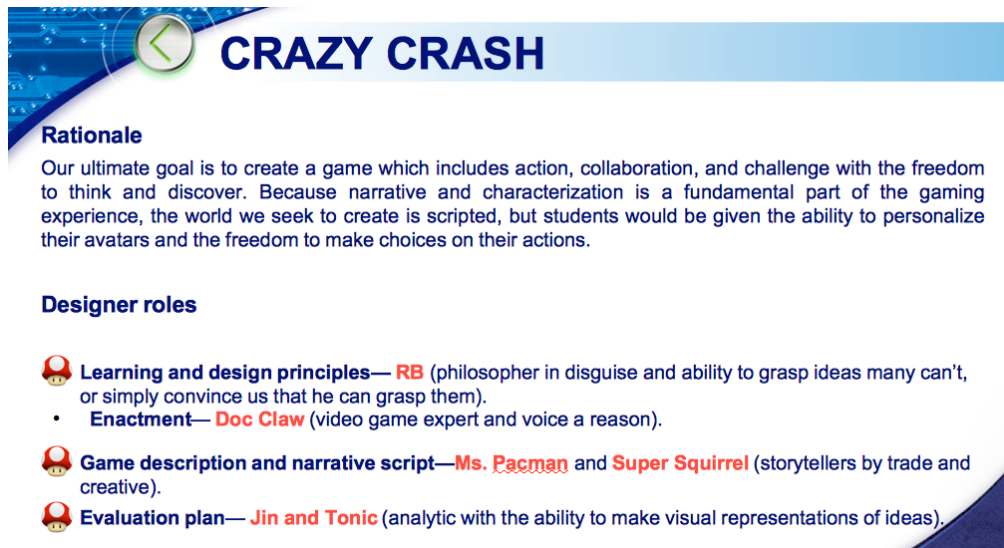
		Max. experience points per event	Max. # of repetitions scored	Maximum points to be earned (5000)
Checking-in	Class attendance	80	10	1000
	Daily self-reporting of XPs	20	10	
Microblogging	Prototype sharing	90	9	4000
	Article reaction/game review	150	20	
	Commenting	20	40	
	Resource sharing	20	20	

Figure 1: Learning by playing games (Experience Points).

XPs and avatars. In general, there was much less concern about sharing XPs since it was kept private but the learners had different takes on avatar use. A majority of them accepted that clarifying doubts became easier through their posts on Google + on account of anonymity. The learners also acknowledged being careful not to reveal their online identities during face-to-face

discussions in class. As we have seen in Doc Claw's example earlier, some students played the game of figuring out their peers and hiding their own identities.

Working together as a community and teams. The team formation in the second iteration was facilitated by a "game jam" activity on the first day. This new activity helped include students who were not part of the cohort to join a team based on the topics of interests. The teams were formed based on initial interests: a simulation game, a game that resembles spiral curriculum approach, a game for adult learners (especially educators), and a game connecting to physical activities. Their classroom roles emerged through their individual leadership within small groups or as a class. The latter was evident particularly during the gaming sessions when learners with expertise in certain games provided assistance on playing the game, explaining game content with analogies that helped a deeper discussion on the day's topic.

Figure 2: A slide from a team introduction.

Similar role-definition and role-playing were observed during their in-class group work. Some learners played with the game concepts to identify and build on to their strengths by calling them "super powers" and assumed different roles and responsibilities to proceed with the game design.

For example, learners with programming skills focused on game design while curriculum experts scaffolded the learning content and brought in the links to the learning outcomes. Figure 2 shows a group's introduction of their team members and their roles. Their names are replaced with their avatar names (in red). From a social perspective it became apparent that the interactions both within class and through microblogging contributed to the development of a stronger community.

THE THIRD PROPOSED ITERATION USING ROLE-PLAYING GAME MECHANICS

The third iteration of the course intends to integrate course mechanics, aesthetics, and tropes normally associated with tabletop role-playing games (RPG). The first two iterations of the course have integrated many attributes familiar to participants from digital games. Using RPG tropes will help emphasize to participants that the principles do not solely apply or come from digital games. It will also create a stronger alignment between course activities and game design principles, making in-class activities more playable. Experience points (XPs) will continue to be used and are a crucial part of the group and individual assignments. Avatars will be more fully realized as participants take on roles that define their interactions with the key game design concept cards used in the assignment. The participant roles will govern the type and quantity of concept cards they can address during the redesign and as a result also their roles in the group.

The roles or character classes to use the original mechanics language are: disciplinary (drawing up to five cards from one category), interdisciplinary (drawing two cards from two categories), and multi-disciplinary (three cards total from any combination of categories). This assignment of roles, and the particular titles used will highlight the importance of collaborative and often multi-disciplinary work that goes into a gamified classroom. The roles will offer meaningful choice for participants and help structure their group interactions. This change enriches the emerging roles

and leadership observed in the second iteration, and structurally incorporates the gaming aspect to their group work. The group course design assignment takes advantage of RPG style character record sheets to record information about individual participants, the course they are designing as a group, the individual's role in relation to concept cards, and manages the accumulation and recording of experience points. Each time they address a course concept in their course design they earn the experience points listed on that concepts card.
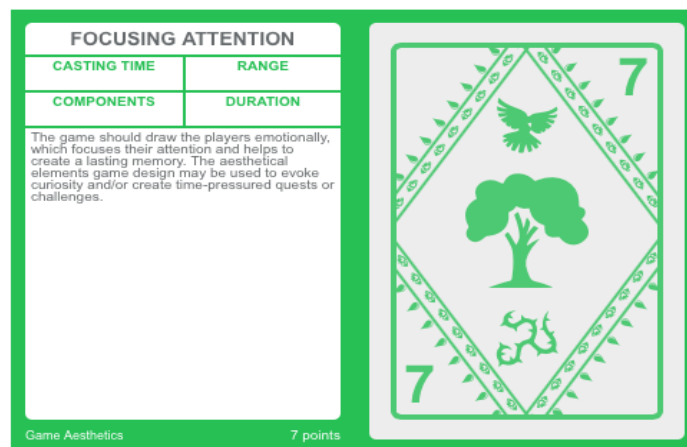
Figure 3: An example key concept card (front and back).

The game design concepts are organized and presented using a fan made online tool to generate Dungeons and Dragons 5th Edition spell cards (see Figure 3). Allowing for capture of key concepts and definitions, meaningful groupings with headings and colour, these cards carry point values to be attributed to their application. The concept cards will be linked to other course content, including games played during the course thus integrating the entire gaming experience. The importance of the concept determines the card value or points helping to ensure attention to such concepts. In addition, if a participant draws a card with an intent to address it meaningfully in their game design but fails, the point value of the card is subtracted from the experience points earned, re-emphasizing the importance of higher point cards.

CONCLUSION

The first and second iteration of the course design put a strong emphasis on playing digital games and making the assessments more game-like. We observed the need to make the face-to-face discussions and in-class group work more playable in which they make moves to advance their game design ideas and to develop each learner's own expertise. At the same time, as seen in the Doc Claw's example, there was a sense of disconnect between their avatar identity and the self in the classroom, even though students favoured its gameful aspects. Our design for the next iteration will focus on helping learners to develop their stance and expertise both online and in-class activities. This will include creating meaningful representations of avatars (e.g., implicitly indicating their viewpoints or expertise) and working through the in-class RPG carefully as a community of learners. From our research perspective, we would look into collecting more in-depth and rich data to capture participants' discussion beyond the observation note, in order to better understand their arguments and moves put forward as learners and players.

REFERENCES

Kim, B. (2014). A graduate course as a game to learn about digital game-based learning. In A. P. Preciado (Ed.), *Proceedings of the IDEAS 2014: Rising to Challenge Conference* (pp. 103–112). Calgary, AB, Canada: University of Calgary.

McGonigal, J. (2015). I'm not playful, I'm gameful. In S. P. Walz & S. Deterding (Eds.), *The gameful world: approaches, issues, applications* (pp. 653–658). Cambridge, MA, USA: MIT Press.

Ramirez, D., & Squire, K. (2015). Gamification and learning. In S. P. Walz & S. Deterding (Eds.), *The gameful world: approaches, issues, applications* (pp. 629–652). Cambridge, MA, USA: MIT Press.

Sheldon, L. (2011). *The multiplayer classroom: Designing coursework as a game*. Boston, MA, USA: Cengage Learning.

Thomas, D., & Brown, J. S. (2011). *A new culture of learning: Cultivating the imagination for a world of constant change*. Lexington, KY, USA: CreateSpace.

PROFESSIONAL COLLABORATION AS RESPONSIVE PEDAGOGY

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In this paper, action research is explored as a process for professional learning and collaboration among post secondary teachers. Qualitative data from reflective journals maintained by instructors who taught multiple sections of a masters research course over a two-year period informed the exploration of responsive pedagogy. Action research is discussed as a methodology used by instructors to reflect on practice in order to engage in continuous quality improvement of learning in higher education. The authors share how action research proved to be a valuable methodology used to guide this reflective experience and can be used to inform ongoing instructional design processes and future research.

Keywords: Action research; Collaboration; Professional learning; Reflective practitioner

RESPONSIVE PEDAGOGY

Signature pedagogy is defined as teaching that is representative of the profession or the discipline (Shulman, 2005). In the learning sciences, a field that studies teaching and learning, it is understood that collaboration can contribute to collective learning (Sawyer, 2014). As such, the authors engaged in professional collaboration using an action research methodology while teaching a research course in a Master's of Education Program in blended and online formats.

The focus of the team collaboration and action research study was to reflect on practice and improve learning experiences for students while the learning was taking place and to inform future course iterations. The instructors shared common practical problems while teaching the course and aimed to use action research as a way to study these issues. A dynamic action research process provided the authors with an opportunity to interrogate their practice and engage in professional learning conversations. While examining the action research process, three descriptive themes emerged: collaboration, challenges, and reflection. These three themes describe the common points of dialogue and debate that informed a responsive pedagogy used in a graduate level research course.

METHODOLOGY

An action research design can be used by a group of teachers in order to improve quality of their teaching (Mertler, 2014; Parsons, Hewson, Adrian & Day, 2013). Drawing on Creswell's (2015) six characteristics of action research, the authors engaged in ongoing professional collaboration using action research. The focus was to improve understanding of action research and to inform improvements in teaching. Each instructor maintained a reflective journal while teaching multiple sections of the research course over a two-year period to examine their own practice and reflect on their own teaching. The collaboration involved the instructors meeting and consulting with one another regularly as well as providing each other with feedback. This dynamic process of reflection-action occurred iteratively. As part of the process, the instructors developed a plan of action and ideas for sharing their research. Creswell's six characteristics of action research are depicted in Figure 1.
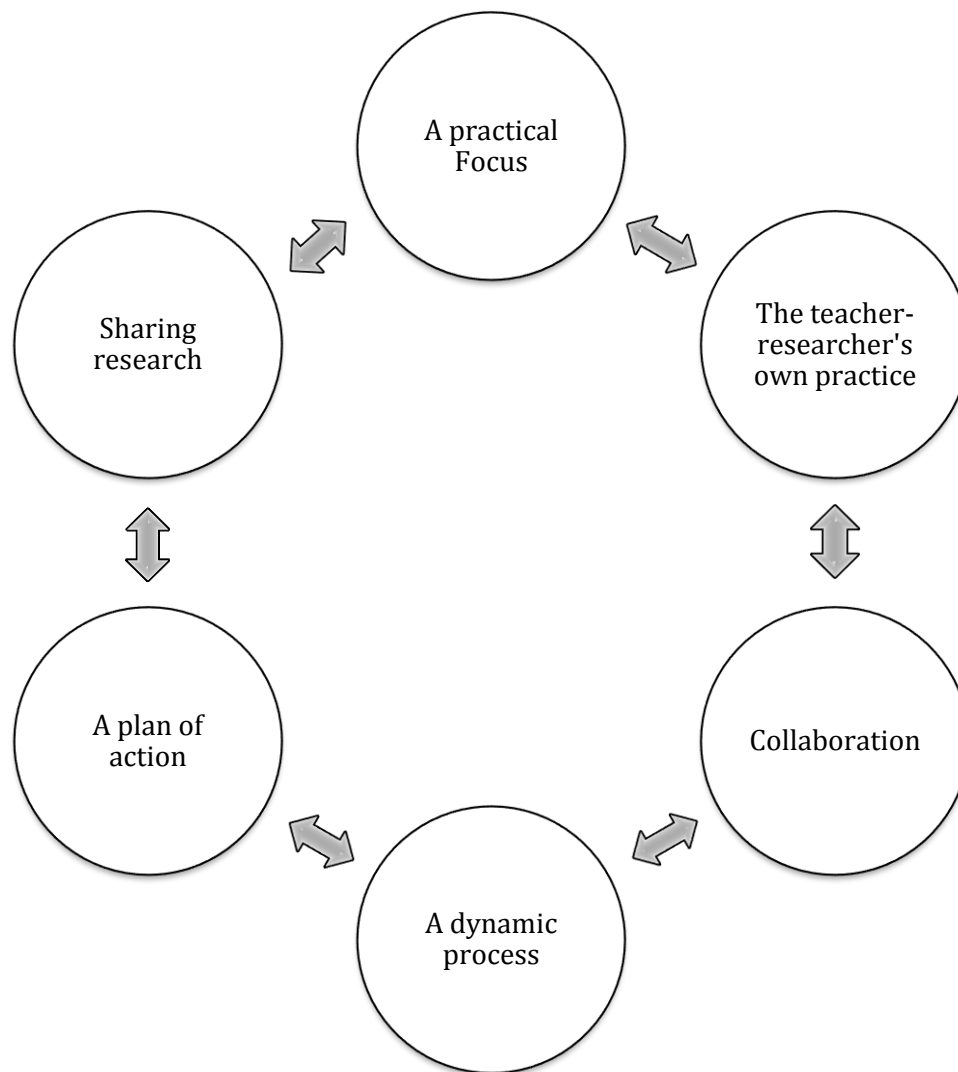
Figure 1: Characteristics of action research informing a professional collaboration (adapted from Creswell, 2015).

FINDINGS

Carrying out action research on teaching action research proved to be a valuable reflective experience and can be used to inform ongoing instructional design processes and research. The instructors engaged in action research through (a) reflecting on practice to continually be responsive and make improvements (b) collaborating to construct shared meaning, and (c)

discussing and debating common issues with teaching the course. The following illustrative examples demonstrate how the instructors used action research to inform their practice (These findings were presented at the IDEAS 2015 Designing Responsive Pedagogy conference in the form of a role play card game. These cards can be found at: https://goo.gl/C5z7hW).

Reflection

As part of the action research process, the instructors collaborated and consulted with each other on a regular basis to discuss concerns about teaching and provide each other constructive feedback. The collaboration was an iterative process of reflection-action (Parsons et al., 2013) in which they used their collaborative learning experience and reflections to inform subsequent iterations and improvements to course design. The instructors engaged in a spiral of activities between reflection, data collection and action to improve instruction and meet the needs of learners. They shared their professional learning from engaging in action research with the broader research community through conference presentations and articles. In this way, the instructors reflected on their teaching for continuous quality improvement.

Collaboration

The instructors collaboratively engaged in this research about their practice to improve quality of their teaching and instructional design through ongoing and cyclical stages: planning, acting, developing and reflecting (Mertler, 2014) and constructed shared meaning in the several ways. The instructors used research journals to record professional insights, observation and ideas occurring as they engaged in action research to study and improve their practice alongside their peers. The instructors maintained reflective journals and notes from communications and meetings to improve practice and used these as part of a dialectic process of reflection to improve the quality of courses.

The instructors communicated with each other electronically and in-person to exchange ideas (i.e. ask questions, share student exemplars, etc.) about practice as part of the action research process. While planning and teaching their courses, the instructors used shared online documents to collaborate further. In these ways, the instructors achieved more adaptive and coherent learning designs through intentional collaboration, reflection and responsive pedagogy.

Challenges

Three specific teaching challenges were identified and explored through this action research. First, negotiating ethical challenges can be daunting for students as novice researchers and with time limitations set by course end dates. As a result, the instructors developed a variety of options for students to engage in action research experiences that were not dependent on receiving ethics approval. Second, supporting students in writing action research proved challenging. The instructors supported students in examining and synthesizing literature by providing exemplars from previous students and using sample writing to help students understand the learning criteria and deepen their understanding of action research. As well, instructors provided feedback to students during draft writing stages of their action research reports. Students were challenged to understand ethical considerations in their own action research projects. The instructors shared ideas about improving scholarly writing, including guidance on ethical issues and proper attribution to sources. Third, there is an element of risk-taking involved in sharing work and providing constructive critique to others. The instructors developed structures to support collaboration and peer feedback loops such as collaboratory studio groups (Grego & Thompson, 2008). Studio groups (i.e. groups of 3-4 students) reviewed drafts of work before they were submitted to the instructor. It was a standard expectation for all students that learning in scholarly

community of inquiry involved making work visible and sharing with others (Garrison, Anderson, & Archer, 2000). Students worked in these studio groups with peers and provided feedback about their draft work, and were expected to incorporate peer feedback into their own work. The instructor facilitated this peer feedback by allowing groups to self-create or configure groups based on topic similarity, geographical location or complementary writing strengths, to name a few. These studio groups could negotiate schedules for peer review or use milestones set by the instructor. Through action research, the instructors were able to develop several teaching strategies for each challenge that arose and share them with one another for improvement of their teaching practice.

DISCUSSION

Collaborative partnerships in pursuit of improving learning and developing a responsive pedagogy is a valuable form of professional learning. The authors argue that using an action research approach in collaboration with peers provides meaningful opportunities for shared meaning construction and can inform a responsive pedagogy. The instructors plan to continue building on their action research agenda and engaging in design, implementation and evaluation of courses in blended and online formats.

A limitation of this study is the data collection based on reflective journals of only three course instructors. Additional perspectives would strengthen the data analysis. For example, collecting data from students in the courses could be considered for future research agendas. Furthermore, the authors did not attempt to compare the possibilities and challenges in teaching blended and online versions of the research course but might consider this aspect for future study. Overall, the authors have grown from this professional learning experience from both an instructional and leadership

perspective. This study has potential to inform teachers, leaders and institutions interested in using an action research approach for professional learning and growth and in developing a responsive pedagogy for learners.

CONCLUSION

Action research was used as an approach to inform course improvement and responsive pedagogy in teaching multiple sections of a blended and online graduate level research course. The action research involved four iterative stages of planning, acting, developing and reflecting (Mertler, 2014). Data were collected from three instructors' reflective journals maintained over a two-year period. Creswell's (2015) key characteristics of action research are reflected in this work and continue to guide the authors with studying their practice and instructional design (a practical focus, the educator-researcher's own practice, collaboration, a dynamic process, a plan of action and sharing research). Findings reveal responsive pedagogy through reflection and collaboration that provided professional learning, especially in the areas identified as challenges within the action research course. These instructors found that using an action research approach to study their practice was a valuable approach for instructional design and developed a responsive pedagogy in teaching graduate students in blended and online courses. Future study could involve a deeper exploration of how instructor collaboration informs student learning and assessment.

REFERENCES

Creswell, J. W. (2015). *Educational research: Planning, conducting, and evaluating quantitative and qualitative research* (5th ed.). Boston, MA: Pearson Education, Inc.

Garrison, D.R., Anderson, T., & Archer, W. (2000). Critical thinking in text-based environment: Computer conferencing in higher education. *The Internet and Higher Education*, 2(2), 87-105. doi:10.1016/S1096-7516(00)00016-6

Grego, R. C., & Thompson, N. S. (2008). *Teaching/writing in third spaces: The studio approach*. Carbondale, IL: Southern Illinois University Press.

Mertler, C. A. (2014). *Action research: Improving schools and empowering educators* (4th ed.). Thousand Oaks, CA: SAGE Publications, Inc.

Parsons, J., Hewson, K., Adrian, L., & Day, N. (2013). *Engaging in action research: A practical guide to teacher-conducted research for educators and school leaders*. Edmonton, AB: Brush Education Inc.

Sawyer, R. K. (Ed.). (2014). *The Cambridge handbook of the learning sciences* (2nd ed.). New York, NY: Cambridge University Press.

Shulman, L. S. (2005). Signature pedagogies in the professions. *American Academy of Arts and Sciences*, *134*(3), 52-59.

RESEARCHING THE DESIGN OF A CULTURALLY SENSITIVE LIBRARY SCIENCE COURSE

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This paper critically explores the importance of culture, its relevance to, and the importance of its inclusion in course design particularly within the Caribbean context. The paper further argues for the design of a culturally sensitive library science course that provides a bridge to undergraduate studies for paraprofessional library staff within the English speaking Eastern Caribbean. Given the Caribbean's geographic dispersion, its shared historical experience of colonialism, slavery and the cultural hegemony of developed countries, a focus on the preservation of culture is required and an online course is appropriate.

Keywords: Carribbean culture; Culture; Cultural difference; Culture and course design; Intercultural learning; Instructional design; Instructional technology; Culture online

The Organization of Eastern Caribbean States (OECS) is a nine island sub-group of islands within the Caribbean with a combined population of over 600,000. Within the OECS, tertiary education is not yet fully developed: only about 3-7% of the population access higher education and students in increasing numbers travel abroad to study (Crooks-Johnson, 2014). In response to this context, in 2007 the University of the West Indies (UWI) established its Open Campus through which it currently offers 800 accredited programs using various modalities including online and distance learning. UWI offers courses for pre-university education, certificate, diploma, and undergraduate programs, postgraduate degree programs, extension courses, technical and vocational, and other

continuing studies courses (p. 12). In spite of these advances, and although UWI offers Bachelors and Masters degrees in Library Science (LIS) as on-campus programs, neither UWI nor any tertiary institution of learning within the OECS offers certificate or diploma courses accessible by OECS member states, that prepare paraprofessional library staff to transition into the first degree. The majority of paraprofessional staff in libraries in the OECS have no formal training. Completing a degree through distance learning transformed my life. I acquired improved interpersonal skills, specialized managerial skills, and received increased remuneration. I saw the value of distance education for those from small developing nations such as ours, especially for women who form the core of library workforce, and want to advance in the workplace, but not at the cost of leaving home and family. Thus the online learning context has become my focus as I pursue the PhD. Library staff practice in a technology-rich networked environment where knowledge and skills are required online. An online program designed to meet the academic needs of library paraprofessionals within the sub-region would be uniquely positioned not only to offer LIS training that provides a bridge to the first degree, but it would also help to overcome the geographical distance, thus connecting students scattered throughout these islands. My research proposes that a culturally sensitive library science course can be developed, designed and delivered online to paraprofessional library staff.

WHY FOCUS ON CULTURE IN THE DESIGN PROCESS?

An examination of the definition of culture underscores its importance to education and why it should be considered in course design and development, particularly design and development for the local context. Hofstede's definition of culture as "the collective programming of the mind which distinguishes the members of one human group from another" (Hofstede 1986, p. 301)

indicates the subtle shaping of the individual by society's culture. Henderson (2007) has provided a detailed definition that reveals the constituents of culture and captures its vulnerability and instability, the idea that culture is not static. It is:

> The way of life of a people. It is the manifestation of the patterns of thinking and behavior that results through a group's continuing adaptation to its changing social, historical, geographic, political, economic, technological, and ideological environment. Culture incorporates race, ethnicity, religion, class, gender, values, traditions, language, lifestyles, and nationality as well as workplace and academic cultures (p. 131).

Gregory (2006) has noted that culture includes race, ethnicity and class, and plays a crucial role in the socialization process since it is prescribed by society's ideas and values. Our culture is a deeply rooted part of our identity, what we value, and the way we think. Culture is not a singular, monolithic construct. Rather it is a diverse set of practices among nations, societies, communities, organizations, institutions, and individuals (Seufert, 2002). Cultural diversity is now recognized as a valuable asset to be preserved and used to solve current and future problems. Henderson (2007) notes that internationalization/globalization of culture can lead to exclusion, marginalization and cultural homogeneity with Western knowledge and culture being conveyed as "natural, necessary, and, in effect, beyond criticism" (p. 132). However, consideration of culturally embedded norms is a deeply ontological and epistemological matter that impacts the choice, design, and use of technology in the learning environment. Our assumptions about how we know, how we come to know, how we communicate what we know, how we choose teaching and learning strategies are informed by the cultural norms, values and discourses that underpin them. These cultural discourses are imbedded at the individual, interpersonal, institutional, regional and national levels and are transmitted as we teach, and through the various other interactions in the learning

environment. Henderson (2007) has noted, "How instructional design of e-learning and e-teaching takes cognizance of multiculturalism and internationalization is exemplified by focusing on the ways it includes and excludes issues of culture" (p. 131). A focus on culture in the design phase of writing a new course is considered a counter response to globalization (Parrish & Linder-VanBerschot, 2010).

PARTICULAR CONSIDERATIONS FOR CARIBBEAN CULTURES

Given the similarity in such cultural antecedents as economy, history, and political systems, there are some commonalities in cultural values among the islands of the English speaking Caribbean. However, although each island state within the English speaking OECS has a common colonial and slave past, yet, it was experienced differently. The islands were colonized by different powers at different points in time (George & Lewis, 2011). So their histories are the same, yet different. Even in a country as small as Antigua and Barbuda, the population is a blend of individuals from different cultures. Eric Williams, former prime minister of Trinidad and Tobago, typifies the dualism of unity and cultural diversity:

> There should be no Mother India for those whose ancestors came from India. . . . there can be no Mother Africa for those of African origin... there can be no Mother England and no dual loyalties,...there can be no Mother China even if one agreed as to which is the mother; and there can be no Mother Syria and no Mother Lebanon. A nation like an individual, can have only one mother. The only mother we recognize is Mother Trinidad-Tobago, and Mother cannot discriminate between her children (as cited in London, 1991, p. 16).

Antigua and Barbuda, and perhaps the entire Caribbean region, are at the cusp of a dualism in relation to culture. We experience a sense of being overwhelmed by certain aspects of Western

culture (for example the arts, religion, language, and educational theories and concepts), which impinge on our culture, yet are both welcomed and resisted. George and Lewis (2011) perceived the intersection of the global and the local as a place of tension, trepidation, and possibilities for small vulnerable states, former colonial societies striving for meaningful independence while at the same time dealing with the challenge of globalization. They contend that:

> The response of Caribbean states must include deliberate processes intended to unearth, document, preserve and disseminate local knowledge especially via the school curriculum. By 'local knowledge' here we mean both indigenous expressions of creativity that have been passed down across generations…. as well as more conventionally generated knowledge (p. 721).

They further pointed out that education in the Caribbean is seen as imported in a similar way that our legal system, government structures, and religions are imported, and that we have a history of looking beyond us for content and standards. As a result, local concerns are rarely addressed. Where the culture of larger countries/societies undermine and erode the everyday processes within smaller countries, education is seen as one of the ways through which cultural globalization can be countered. George and Lewis (2011) posited that the Caribbean has an unfinished education agenda where we have not yet articulated ways of bridging the gap between the local and the global. They suggested that if local communities are to avoid globalization as a new form of colonization, then a third space must be created where the local and the global meet.

MODELS FOR CULTURAL INCLUSION

Models have been developed to locate cultures that might be used to ensure local/national presence in this third space. Parrish and Linder-VanBerschot (2010) seeking to locate the cultural

dimensions of learning that are most likely to impact instruction, explored cultural differences through the lens of the cultural dimensions of learning framework (CDLF). The CDLF constitutes eight cultural dimensions related to "social relationships, epistemological beliefs, and temporal perceptions" illustrating how they might vary in the learning environment (p. 1).

However, the model developed by Hofstede seems the most influential. Masoumi and Lindström (2012) noted that anthropologists such as Hofstede have identified dimensions of cultural variation to explain how individuals in different cultures "communicate, behave, perceive time, or view themselves in relation to others and to the environment" (p. 396). Hofstede (1986) identified five cultural dimensions that have been used by researchers and course designers to define cultures. The power-distance dimension acknowledges that while there are inequalities in all societies, some societies are more unequal than others, and characterizes the degree to which the inequalities in power within a society are accepted as normal by the less powerful. Uncertainty-avoidance denotes the degree to which individuals within a particular culture are able to cope with situations that are not clearly defined, are unstructured, or unpredictable and which they seek to avoid through objectivist absolutism and the establishment of strict codes of behaviour. Masculinity versus Femininity addresses the degree to which traditional gender roles are observed within a society. Men are considered more aggressive, assertive, leadership-oriented and focused on achieving material success, while women are perceived as being nurturing, having modest ambitions, and seeking to balance equity. Long- versus Short Term Orientation or 'Confucian Dynamism' describes the degree to which individuals within a society focuses on maintaining their traditional values. For example, how quickly do they want results in spite of negative future impact? Collectivism versus Individualism characterises the strength of the ties between individuals. Individualist societies are loosely integrated cultures in which individuals are expected

to look after their own interest. In contrast, collectivist cultures are tightly integrated, and individuals are positioned within them through birth or later circumstances into "in-groups" such as the extended family, spouse and children. The group protects its members in return for their permanent loyalty.

Hofstede's model has been critqued. Holfstede's samples were drawn from a single multinational organization, in which most of the participants were middle-class males. The study focused on national cultures ignoring subcultures within the various societies. The study is dated. There is a danger of stereotyping, and a normative influence in the dimensions (Cronjé, 2011).

DESIGN CONSIDERATIONS FOR CULTURAL INCLUSION

Instructors and instructional designers should recognize the social situatedness of learning and consider the embeddedness of their subjectivities in teaching and instructional design. How can distance educators integrate diverse learners into the online community? How can they be sensitive to diversity? Lauzon (2000) suggested that designers need to be aware of their biases and prejudices, and adopt a critical stance that challenges their personal points of view. What do we know? How did we come to know? Who decides which knowledge is legitimate? This is particularly important when designers are designing for a culture other than their own (Parrish & Linder-VanBerschot, 2010). Technologies are not value neutral. They are infused with the cultural assumptions of their originators. Design is impacted not only by the content but also by what instructors and designers believe about both the content and the technologies they use.

For instruction to be culturally relevant instructors/instructional designers need to familiarize themselves with students' cultural knowledge and experience which is drawn from their social interactions in their societies/communities (George, 2013). Culture should be represented

respectfully and intercultural design considerations should not be "cosmetic, tokenistic, and/or stereotypical" (Henderson, 2007, p. 132). Any focus on online course design should include the worldviews of those involved in the learning context, and the specific requirements of the academic culture. Materials should explore systemic issues related to power, control, and disadvantage. Multi-racial and ethnic knowledge should be privileged, legitimized, and included in meaningful ways. Gender issues relevant to both male and females should be included.

IMPLICATIONS

This paper responds to the need to critically explore the importance of culture and its relevance to and inclusion in course design. No institution of learning in the OECS offers paraprofessional library science courses online. Given the Caribbean's shared historical experiences of colonialism, slavery, and cultural hegemony from developed countries, a focus on the preservation of culture is required. If an online library science course for Caribbean paraprofessionals is to be offered, it is important that Caribbean-specific cultural issues be in the forefront in both the design and the instruction.

REFERENCES

Cronjé, J. C. (2011). Using Hofstede's cultural dimensions to interpret cross-cultural blended teaching and learning. *Computers & Education, 56*(3), 596-603.

Crooks-Johnson, B. S. (2014). The University of the West Indies open campus: A beacon for distance education in the Caribbean. *Distance Learning. 11*(2), 11-18.

George, J. M. (2013). 'Do you have to pack?' –preparing for culturally relevant science teaching in the Caribbean. International Journal of Science Education. 35(12), 2114-2131. Doi: 10.1080/09500693.2012.760138

George, G., & Lewis, T. (2011). Exploring the global/local boundary in education in developing countries: the case of the Caribbean. *Compare: A Journal of Comparative and International Education*, *41*(6), 721-734.

Gregory, S. T. (2006). The cultural constructs of race, gender and class: A study of how Afro-Caribbean women academics negotiate their careers. *International Journal of Qualitative Studies in Education*. *19*(3), 347-366.

Henderson, L. (2007). Theorizing a multiple cultures instructional design model for e-learning and e-teaching. In A. Edmundson (Ed.), *Globalized e-learning cultural challenges* (pp. 130-154). Hershey, PA: Information Science Publishing.

Hofstede, G. (1986). Cultural differences in teaching and learning. *International Journal of Intercultural Relations*, *10*(3), 301-320.

Lauzon, A. C. (2000). Distance education and diversity: Are they compatible? *American Journal of Distance Education*, *14*(2), 61-70.

London, C. B. G. (1991). Forging a cultural identity: Leadership and development in mass education in a developing Caribbean country. *Journal of Black Studies*, *21*(3), 251-267.

Masoumi, D. and Lindström, B. (2012). E-learning as a cultural artifact: An empirical study of Iranian virtual institutions. *M*. Strano, H. Hrachovec, F. Sudweeks and C. Ess (Eds). In *Proceedings Cultural Attitudes Towards Technology and Communication 2012*, (pp. 393-409) Murdoch University, Australia.

Parrish, P., & Linder-VanBerschot, J. (2010). Cultural dimensions of learning: Addressing the

challenges of multicultural instruction. *International Review of Research in Open and Distance*

Learning, 11(2), 1-19.

Seufert, S. (2002). Cultural perspectives. In H. Adelsberger, B. Collis, & J. Pawlowski (Eds.),

Handbook of information technologies for education and training (p. 411–421). New York:

Springer.

MUSIC-BASED ACTIVITIES TO PROMOTE UNDERSTANDING AND ACQUISITION OF LANGUAGE FOR CHILDREN WITH AUTISM SPECTRUM DISORDER

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Individuals with autism spectrum disorder respond positively to music. This is due, in part, to their ability to perceive and remember isolated pitches and identify the contour of melodic fragments. As well, a positive relationship exists between a child's ability to vocalize musically and the ability to speak. These observations support the use of music-based activities for students with ASD to practice and demonstrate their abilities to perceive pitch. Educational experiences through songs and singing also provide opportunities for these children to combine their perceptions of pitch, their ability to vocalize musically, and their ability to form words.

Keywords: Autism; Education; Music

AUTISM AND PITCH PERCEPTION[1]

It is widely noted that individuals with autism spectrum disorder (ASD) enjoy interacting with others through music (Wan, Demain, Zipse, Norton, & Schlang, 2010). Teachers may observe that students with ASD show interest in music in many different ways. They may be excited when they see their favorite percussion instruments (e.g., hand drum), they may perform the motions that accompany actions songs (e.g., *If you're happy and you know it*), and may even join their peers in singing the lyrics of their favorite songs. This seemingly innate sensitivity to music may be attributed, in part, to the ease with which individuals with ASD are able to remember and

discriminate tones. In this regard, Heaton, Hermelin, and Pring (1998) observed that children with ASD were more proficient at identifying and remembering isolated tones than their typically developing peers. In addition, Heaton (2003) found that children with ASD were better-able to remember and identify tones embedded within musical chords (e.g., three or more tones sounded simultaneously) than their non-autistic peers. Continuing research in a similar vein, Heaton (2005) noted that children with ASD performed better than their typically developing peers when asked to indicate whether a group of successive tones formed ascending or descending patterns.

Many children with ASD are able to produce and replicate pitch. At first vocal responses may seem involuntary but, with time and exposure to music, children find ways to communicate with others vocally through music. They may begin this process by relaying enjoyment in musical interactions by emitting verbalizations that are not readily recognizable as formal language. Over time, children may begin to reproduce the melody (or parts of the melody) of familiar songs. Through continued practice, the words that accompany the melody may become distinguishable in their vocal performances.

SINGING AND LANGUAGE DEVELOPMENT

Delays and deficits in language development are one of the defining features of ASD (American Psychiatric Association, 2013). Students with ASD display a wide range of verbal behaviors. Many individuals with ASD do not use language; some are able to use single words to communicate. Up to fifty percent of people diagnosed with autism do not acquire functional speech (Preston & Carter, 2009). Of these, atypical patterns of pitch, rhythm, and stress are common.

Research findings support the use of songs and singing to help children with ASD acquire language (Lim, 2012). Support for this approach is found in MacMillan and Saffron (2004) who highlight the similarities between these modalities. Both language and music exist in time. As well, both are

perceived as pitch patterns that, when grouped together, transmit cultural meaning. In language, these sounds are interpreted as words; in music, tones are understood in relationship to intervals and scales. Given the similarities between language and music, it would seem that the acquisition of proficiency in one medium might influence the proficiency in the other.

Implications for education

Research findings indicate that children on the autism spectrum have a natural affinity to perceive pitch (Heaton, 2003, 2005). As well, Edgerton (1994) revealed a relationship between a child's ability to vocalize musically and the child's ability to speak. These observations support the use of music-based activities for students with ASD to practice and demonstrate their abilities to perceive pitch. In addition, educational experiences through songs and singing provide opportunities for these children to combine their perceptions of pitch, their ability to vocalize musically, and their ability to form words. The following series of activities provide examples of informed practice.

Activity 1: Slide whistle

A first step in being able to reproduce melodies is to aurally perceive the patterns created by a group of pitches. This activity provides students opportunities to practice this skill. The teacher plays patterns on a slide whistle (Kranowitz, 2003). The students create movements to demonstrate their awareness of the shapes created by these aural patterns. They might sit in chairs and create movements with their upper bodies while sitting in chairs; they might create movements with their entire bodies while standing. The tones produced by the slide whistle can be manipulated in a number of ways to produce sounds that:

- move along the entire range of the whistle from low to high or high to low;
- move quickly or slowly;
- move partway up or down the slide and suddenly stop;
- quiver swiftly back and forth.

Once children become involved in this game they may begin to produce the contour of the pitches with their voices. This creates a bridge to the activities that follow.

Activity 2: Birds and bees

In this activity students demonstrate their ability to perceive and reproduce melodic contours created by the flight patterns of birds and bees. When first implementing this activity, the leader (usually the teacher) stands at one side of the classroom holding a toy bird or bee. The leader *flies* the bird or bee across the room and the children produce vocal sounds (e.g. hum or bzzz) to show the contour of the flight path. Once children are familiar with the activity, a child can be chosen to *fly* the bird or bee. Two-part singing is created when two children construct flight paths simultaneously and their peers decide which of the contours to follow with their voices.

Activity 3: In a hot air balloon

This activity demonstrates another way that children may demonstrate melodic contour with their voices. The teacher draws a picture of an out-of-doors perspective on a white board. This could be a cityscape with tall buildings and roads or a rural view with fields and trees. On one corner a hot air balloon is drawn. A contoured line is drawn from the balloon and across the picture. The children use their voices to create sounds that show the contour of the balloon's trajectory. Alternately, the teacher could create a hot air balloon with a basket, some strings, and balloons and then *fly* the balloons across the illustration. This could be combined with visuals from the book *Up, up, up* (Reed & Oldfield), a story about the adventures of children in a hot air balloon.

Activity 4: Songs with simple repeated texts

Teachers may guide students with limited verbal skills toward singing by encouraging them to vocalize with portions of songs. The song *Old MacDonald* is an ideal vehicle for this process as it

contains the repeated motive E-I-E-I-O. Students are encouraged to take part in the singing in whatever way best suits each individual. Some students may create the expected vowel sounds, while other students may produce personal verbalizations that represent these sounds. This song has several verses, each following the same structure. This provides multiple opportunities for students to practice producing these vowel sounds.

Activity 5: Sing hello

In promoting language development through music education, *singing hello* is an introductory activity that encourages students to integrate language with their ability to reproduce the pitches they hear. The teacher kneels in front of a student and sings hello into a microphone (e.g., a plastic microphone purchased at a discount store). She then holds the microphone toward the student and prompts him to say hello. This may take some persistence because, in the beginning, students may demonstrate echolalic behavior (e.g., imitating what the leader has said). For example, the teacher sings *hello Jennifer* and instead of singing *Hello, Mrs. Lawrence*, the child sings *hello Jennifer*. With careful modeling over time (e.g., demonstrating how other students address the teacher), Jennifer may learn how to exchange greetings. After students are able to sing *hello*, these greetings may be extended to short conversations such as *where do you live?* (teacher's question) and *Calgary* (student's response).

Activity 6: Rhythm sticks as building blocks to speech

Rhythm in song is the pattern of sounds and silences determined by the text. Simply put, rhythm is the way the words go (Choksy, 1999). Prior to this intervention, children are able to play rhythm sticks, holding one stick stable while coordinating eye-hand movements so that the other stick taps the middle of its' partner. The teacher sings *Alberta springtime* (Figure 1) to the students on several occasions so they become familiar with the piece.
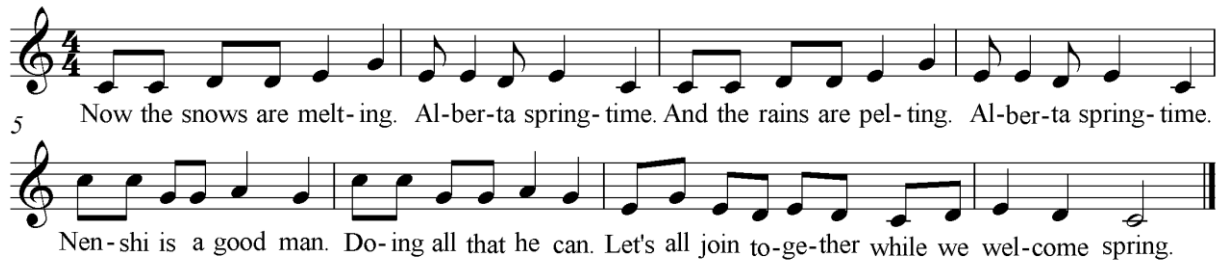
Figure 1: Alberta Springtime (Scott, 2015).

The teacher sings the song and models playing the rhythm sticks on the repeated words *Alberta springtime*. She then provides students with rhythm sticks. The teacher sings the song and students join in playing the rhythm of the words in time with these repeated sections. While the teacher might begin by playing along with the students, this assistance is removed as soon as possible so that students take ownership for their part.

Activity 7: Kazoos as building blocks to speech

After students are able to play the rhythm, they are encouraged to vocalize this pattern. One way to do this is with kazoos. The teacher may begin by modeling the song, singing most of the lyrics, but playing a kazoo for the *Al-ber-ta spring-time* motive. Students are then given kazoos. The teacher sings the lyrics and, either alone or along with the teacher, the students play this motive with their kazoos. Following this practice, the teacher encourages the students to perform this motive with the words.

SUMMARY

As I interact with teachers I realize that many of them struggle to find ways to involve students with autism spectrum disorder in their classes. They want to offer these students the best education possible, but do not know how to do so. The natural affinity students with ASD have toward music may create avenues for involving these individuals in educational experiences.

Students with ASD display a range of verbal abilities. For those with limited verbal abilities, music-based activities offer opportunities for children to practice and display their abilities to perceive pitch, to vocalize musically, and to form words. The educational interventions described here provide examples of a range of interventions beginning with activities in which students display pitch perception through movement, to activities in which students create vocalizations to reflect aural perception and, finally, activities that link vocalizations to the formation of words.

Working with students with ASD requires that teachers carefully observe and respond to the students' reactions to their educational environments. These interventions are not a set of teaching recipes. While many of these ideas are suited to learning communities beyond my own, educators must not presume to transfer this advice to their own classrooms. Rather, they must adapt and reshape these ideas, creating environments responsive to the immediate needs of their students. I hope that the work I share helps educators on their personal journeys, creating and recreating educational contexts for their students.

Notes

[1]Portions of this literature review are abbreviated from *Building bridges: Music education for children with autism spectrum disorder* (author, unpublished manuscript).

REFERENCES

American Psychiatric Association (2013). *Diagnostic and statistical manual of mental disorders*

Choksy, L. (1999). *The Kodaly method I* (3rd ed.). Upper Saddle River, NJ: Prentice Hall.

Edgerton, C. L. (1994) The effect of improvisational music therapy on the communicative behaviors of autistic children. *Journal of Music Therapy*, 31, 31–62.

Heaton, P. (2003). Pitch memory, labeling, and disembedding in autism. *Journal of Psychology and Psychiatry, 44*(4), 543-551.

Heaton, P. (2005). Interval and contour processing in autism. *Journal of Autism and Developmental Disorders, 35*(6), 787-793.

Heaton, P., Hermelin, B., & Pring, L. (1998) Autism and pitch processing: A precursor for savant musical ability? *Music Perception, 15*(3), 291-305.

Kranowitz, C. S. (2003). *The out-of-sync child has fun: Activities for kids with sensory processing disorder*. New York, NY: Perigee.

Lim, H. A. (2012). *Developmental speech-language training through music for children with autism spectrum disorders: Theory and clinical application*. London, UK: Jessica Kingsley.

McMillan, E., & Saffran, J. R. (2004). Music and language: A developmental comparison. *Music Perception, 21*(3), 289-311.

Preston, D., & Carter, M. (2009). A review of the efficacy of the picture exchange communication system intervention. *Journal of Autism and Developmental Disorders, 39*(11), 1471-1486.

Reed, S. & Oldfield, R. (2010). *Up, up, up*. Cambridge, MA: Barefoot books.

Wan, C. Y., & Demaine, K., Zipse, L., Norton, A., & Schlang, G. (2010). From music making to speaking: Engaging the mirror neuron system in autism. *Brain Research Bulletin, 82*, 161-168.

COLLABOR-OLOGY: IMPROVING LITERACY AND ENGAGEMENT IN JUNIOR HIGH LANGUAGE ARTS

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This mixed methods study investigates differences in student achievement in a grade nine English classroom when comparing Direct Instruction, a Collaborative Learning Model and a Computer Supported Collaborative Learning Model (CSCL). Quantitative data indicated a statistically significant difference in student achievement between Direct Instruction and each of the collaborative learning models. Qualitative data were analyzed into three thematic categories: Engagement, Student Learning, and Efficacy. A student preference for CSCL emerged.

CONTEXT

The new tenets of 21st century learning are changing classrooms. Students, already engaged with a wide variety of technologies, challenge educators to innovate in the classroom. Alberta has undergone a shift in education towards creating student centred curricula. Integrating technology within the new policy framework represents the initial shift of this curriculum implementation. "Responding effectively to students' literacy needs demands innovative solutions, and clear direction and a commitment to collaboration." (Alberta Education, 2010, p.6) Recent research has

emphasized the benefits of Computer Supported Collaborative Learning (CSCL) environments, which support collaborative tasks, and lead to increased levels of engagement. (Stahl, 2012; Stahl, Lao & Hesse, 2013; Vesisenaho, Valtonen, Kukkonen, Havu-Nuutinen, Hartikainen, & Karkkainen, 2010). Together, these ideas point to the need for innovative change at the classroom level.

Within Alberta, charter schools have been considered programs of choice, "brought in under specific conditions, defining choice according to each charter granted by the province." (The Association of Alberta Charter Schools, [TAAPCS], 2011) In a shifting provincial paradigm, however, these programs may look for ways to adapt. The context for this study was a charter school that champions Direct Instruction (DI) and a loosely defined "traditional" philosophy. The new ministerial mandate for student-centred learning poses a challenge for this school. The DI model centres on covering content and on individual accountability as measured by students' progress and behaviour (Kozioff, LaNunziata, Cowardin & Bessellieu, 2001). Within this study, comparing methods of instruction attempts to explore one part of the 21st Century initiative of collaboration and its effect on student achievement. Several factors converge to motivate the current study: a provincial mandate that includes "Engaged Thinker" and promotes literacy; a program of choice; and integrating technology in the classroom.

This study aims to compare three teaching interventions: the DI teaching method, a Student Collaborative Model and a CSCL model. The DI model centers on covering content efficiently through teacher-directed tasks, guided practice and measured achievement results (Kozioff, LaNunziata, Cowardin, & Besselieu, 2001). In contrast to DI, collaborative learning emphasizes process and conceptual development. The collaborative models share common characteristics: small group discussion to improve conceptual understanding through elaboration, negotiating meaning through integrating various points of view, and co-creating knowledge through

controversy and synthesis of information (Van Boxtel, Van der Linden, & Kanselaar, 2000; Blooma, Kurian, Chua, Goh, & Lien, 2013). The CSCL model generally refers to networked environments where students use computers to work collaboratively (Stahl, Lao & Hesse 2013; Vesisenaho, et al., 2010). CSCL models continue to evolve alongside new research. This study attempted to explore one part of the 21st Century learning—collaboration—and its effect on student achievement and on student engagement within a local and specific context.

METHOD AND DATA COLLECTION

This study is limited to an urban setting in Alberta, within a Charter school that has a small junior high of approximately 165 students. The sample for this study was formed from 48 grade nine students; it is a sample of convenience. The ratio of boys to girls is 29:19 or approximately 60% males. Thirty-six of the students are first generation Canadian and twelve students were not born in Canada.

This study used a mixed methods approach. The quantitative research question for this study was:

1. Will there be a difference in student achievement when comparing Direct Instruction (DI), a Computer Supported Collaborative Learning (CSCL) model and a Collaborative Learning model?

Qualitative research questions were:

2. Will Collaborative Learning have an effect on students' perception of their own learning?

3. Will Computer Supported Collaborative Learning encourage critical thinking and problem solving between peers?

4. Will Computer Supported Collaborative Learning affect student interactions?

5. Will the use of laptops foster collaboration in the classroom?

The duration of each unit of study was three weeks. The DI unit used a set of stories, and the two collaborative units used a novel of comparable difficulty to the story set. Interpretive learning tasks for each of the units included comprehension questions, a picture analysis and short personal written responses. In the Collaborative learning models, student discussions generated new questions or topics within specific student groups as part of the collaborative process. For the Collaborative models, students formed triads of mixed gender; these were chosen by students. New triads were established for each model. The CSCL model used the web-based program, *Socrative,* as the computer support. Quantitative data were collected from a set of posttests administered at the end of each unit of study. The first test was a Summative Unit test and the other, a standardized reading test. Summative Unit Tests used the same format and length; test items were analyzed according to a table of specifications using Bloom's taxonomy. Excerpts from released Alberta Provincial Achievement Tests (PAT) were used for the standardized tests: these were narrative passages of comparable length, question format and difficulty.

Quantitative data were analyzed applying a Single-Sample Analysis of Variance (ANOVA). Qualitative data were collected through student responses to two open-ended questions: What did you like about [intervention]? What did you dislike about [intervention]? One month after the study, students were asked another set of open-ended questions: What were the advantages of [intervention]? What were the disadvantages of [intervention]? Data were collected and analyzed using the constant-comparative method (Glaser & Strauss, 1967). Data were categorized according to emergent themes.

Bartel Nickel

KEY FINDINGS

Quantitative results

The data from the two testing instruments remained consistent. The ANOVA for the Unit tests showed a mean difference of 10.75 between DI and a Collaborative Model of Learning ($p<0.001$). Between DI and a CSCL model ($p<0.0016$) the data indicate a difference of 7.23. When comparing a Collaborative Learning model and CSCL model, no statistically significant mean difference 3.518 ($p<0.137$) appeared. Posttest scores for CSCL and Collaborative Learning were statistically significantly higher ($p<0.003$) than DI. The second ANOVA for the standardized PAT reading excerpts was consistent with the Unit tests: between DI and a Collaborative Model of Learning ($p<0.001$) there was a mean difference of 9.95. The data show a difference of 8.10 ($p<0.008$) between Direct Instruction and a CSCL model. The data show no statistically significant mean difference of 1.85 ($p<0.543$) between CSCL and a Collaborative Learning model.

1. Quantitative data indicated a statistically significant difference in student achievement between DI and a Collaborative Model of Learning. There was an increase in achievement under the Collaborative Model of Learning.

2. Quantitative data indicated a statistically significant difference between DI and CSCL. There was an increase in student achievement under the CSCL model.

3. Quantitative data did not indicate a statistical difference between a Collaborative Model and CSCL.

These results responded to the first research question demonstrating that the method of instruction did make a difference in student achievement.

Qualitative results

Qualitative themes brought forward the voices of the learners as they considered and reflected upon the learning process. Regarding DI, students spoke about the efficiency of this method: "The instructions, methods and expectations are very clear and easy to understand," and, "DI makes the process more clear and simplistic." The student perspective suggests a desire to find the right answer and focus on learning the right information for the task. While students appreciated the directness of DI, some suggested DI contributed to student distractedness, "it (DI) is as boring as a board." Students also recognized that DI "doesn't make use of some of the resources we have available." With respect to Collaborative Learning model, co-creating emerged as one of the benefits: "We put our minds together and came up with a consensus and a sophisticated answer," and, "at the end you saw how your point of view was different." The Collaborative Learning model also helped students reflect on their learning process, and the group triads facilitated "expressing opinion to people you usually don't work with."

Support emerged for each of the interventions, but comments revealed a preference for the CSCL model. Students appreciated comparing personal results through the software program, noting "[*Socrative*] brings in excitement," and it "allowed for more interpretation of the text." One student stated, "We all had a good time." Depth of learning was demonstrated through comments that contrasted perspectives as "useful because you get a collective idea of others' thoughts enhancing your knowledge."

In summary, the key findings of this qualitative data were:

1. The DI model was less engaging, but was appreciated for the clarity of instruction.

2. Students were aware of sources outside the classroom (on-line) which provide relevant and timely information or resources.

3. The CSCL model consistently provided positive engagement.

4. The computer support within the CSCL model facilitated discussion and enabled deeper understanding.

5. The Collaborative model which saw student-led discussion, debate, elaboration and reflection, resulting in high levels of student engagement.

6. The depth of understanding and reflective learning were noted in both CSCL and the Collaborative models.

7. For CSCL and Collaborative models, students commented on the benefits of learning from a variety of perspectives within small groups as well as from discussion.

These results are consistent with previous research around collaborative learning models. Some studies have explored positive effects of CSCL and small peer group interactions (Tsui, 2011; Williams, 2009; Vesisenaho et al., 2010). Stahl and Hesse discuss increased levels of student engagement using CSCL (pp. 268 – 269), urging the use of appropriate interventions. Studies also indicate that collaborative models use student-centered learning environments and foster high levels of engagement. (Istance & Kools, 2013; Gomez, Wu, & Passerini, 2010) Research also supports the conclusion that knowledge is co-created through a collaborative process within a learner-supported environment (Saab, Van Joolingen & Van Hout-Wolters, 2012; Friesen, 2009; Blooma et al., 2013). This study supports research around collaborative models.

CONCLUDING THOUGHTS

Returning to the central questions of this study, the data brought forward some important ideas. From this data, student perception of learning was enriched through both collaborative models. Both collaborative-based interventions facilitated knowledge creation between learners, fostered an interactive, engaging learning environment and encouraged higher level critical thinking skills.

These conclusions are supported in current research that recognizes an urgent need for effective interventions using online platforms (Stahl & Hesse, 2006; Vesisenaho et al., 2013; Blooma et al., 2013).   The study has implications within its context. There is a level of comfort—predictability- in using DI pedagogy. DI may be the tried and true pedagogy in this context, but the collaborative learning models, implemented deliberately, encourage higher levels of engagement and also impact student achievement as demonstrated in this study.

Collaboration encourages reflection and critical thinking; it supports deeper learning. The CSCL model supports a process where students engage in thoughtful debate, elaboration and controversy to negotiate meaning. This process defines the difference between DI and collaborative learning. As part of 21st Century learning, collaborative learning models, particularly CSCL models, foster learning and engagement and do make a positive difference in student achievement.

There are implications for other classrooms that may use DI as the default method of instruction. DI provides an efficient method for content-based instruction, but a more effective impact can be noticed with a deliberate pedagogical choice and design. Using CSCL tasks to challenge, extend and enhance traditional ways of thinking and learning can engage the learners more effectively in their learning process. Using technology to support collaboration meets the learners in their natural space. As learners engage through the technology and the collaborative process, learners create a richer knowledge and learn to appreciate diversity.

Collaborative learning poses challenges: setting up that supportive environment demands a re-thinking of the lesson design, one that moves away from prescriptive efficiency and builds on student interest along with an opportunity to explore those interests. This study showed that digital literacy can be applied through a collaborative learning intervention within the context of a school that is based on a DI model. It showed that different collaborative models will improve student

engagement and contribute to improved student achievement. Collaboration invigorates learning, for teachers and for students.

REFERENCES

Alberta Education. (2010). *Literacy first: A plan for action*. Edmonton, AB: Alberta Education. Retrieved from: https://education.alberta.ca/media/4970645/literacyfirst.pdf

Blooma, M., Kurian, J., Chua, A., Goh, D. & Lien, N. (2013). Social question answering: Analyzing knowledge, cognitive processes and social dimensions of micro-collaborations. *Computers and Education, 69*, 109–120.

Friesen, S. (2009). Teaching effectiveness: A framework and rubric. *WDYLIST Research Series Report 2*, 43-58.

Gomez, E., Wu, D., & Passerini,K. (2010). Computer-supported team-based learning: The impact of motivation, enjoyment and team contributions on learning outcomes. *Computers and Education, 55,* 378 – 390.

Glaser, B. & Strauss, A. (1967). *The discovery of grounded theory: Strategies for qualitative research.* Chicago: Aldine Pub. Co.

Istance, D., & Kools, M. (2013). OECD Work on technology and education: Innovative learning environments as an integrating framework. *European Journal of Education, 48*(4), 43-57.

Kozioff, M., LaNunziata, L., Cowardin, J., & Bessellieu, F. (2001). Direct instruction: Its contributions to high school achievement. *The High School Journal. 84*(2), 54-73.

Saab, N., Van Joolingen, W., & Van Hout-Wolters, B. (2012). Support of the collaborative inquiry learning process: Influence of support on task and team regulation. *Metacognition Learning, 7*, 7 – 23.

Stahl, G. & Hesse, F. (2006). Social practices of computer-supported collaborative learning. *International Journal of Computer-Supported Collaborative Learning*, *1*, 409 – 412 DOI: 10.1007/s11412-006-9004-y

Stahl, G. (2012). Cognizing mediating: Unpacking the entanglement of artifacts with collective minds. *Computer-Supported Collaborative Learning, 7,* 187 – 191. DOI: 10.1007/s11412-012-9148-x.

Stahl, G., Lao, N. & Hesse, F. (2013). Collaborative learning at CSCL 2013. *International Journal of Computer-Supported Collaborative Learning*, *8*, 267 – 269. DOI: 10.1007/s11412-013-9179-y

Tsui, M. (2011). Development of peer-assisted learning strategy in computer-supported collaborative learning environments for elementary school students. *British Journal of Educational Technology, 42*(2), 214-232.

The Association of Alberta Public Charter Schools. (2011). *What is a charter school?* Retrieved from: http://www.taapcs.ca/about.html

Van Boxtel, C., Van der Linden, J., Kanselaar, G. (2000) Collaborative learning tasks and the elaboration of conceptual knowledge. *Learning and Instruction 10,* 311- 330.

Vesisenaho, M., Valtonen, T., Kukkonen, J., Havu-Nuutinen, S., Hartikainen, A., & Karkkainen, S. (2010). Blended learning with everyday technologies to activate students' collaborative learning. *Science Education International, 21*(4), 272-283.

Williams, S.M. (2009). The impact of collaborative, scaffolded learning in K-12 schools: A meta-analysis. *The Meteri Group*. *Commissioned by Cisco Systems*. Retrieved from: http:// www.cisco.com/web/about/citizenship/socio-economic/docs/Metiri_Classroom_ Collaboration_Research.pdf

LEARNING IN PARTNERSHIP: ENGAGEMENT IN

INQUIRY-BASED LEARNING

THROUGH PROFESSIONAL THEATRE

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Inquiry-based learning aims to engage students in the learning process by starting with student questions. By focusing on the big ideas of learning, students are able to meet curriculum expectations and expand their knowledge in ways that intrigue and challenge them. In this partnership, this is done by way of special units of study delivered through the relationship between a school and professional arts organization. This model fosters deep learning for all engaged participants by developing new programs in response to their questions and interests.

Keywords: Drama education; Inquiry-based learning; Collaboration; Professional Theatre; Professional development

INTRODUCTION

The purpose of this paper is to share best practices for fostering inquiry-based learning through partnerships between schools and the professional arts. The case study for this exploration is the partnership between St. Sylvester Catholic School and Young People's Theatre (YPT) in Toronto. Tailored to the specific aims and needs of the school and responsive in its design, this partnership continues to develop. It is one of the most successful examples of collaborative pedagogical practice within YPT's Member Schools program in its impact on both communities.

CONTEXT

YPT is Canada's largest TYA [theatre for young audiences] company and Toronto's oldest not-for-profit theatre - an influential institution, not only in this city, but on the world stage (Pitman, 1998, p. 236). Located in downtown Toronto, it includes two theatres with full theatrical lighting and sound systems. All of the production shops are located onsite. Having ownership of a space like this is part of what allows this company to accommodate large audiences and to focus on high production and aesthetic values, as well as to develop and offer a variety of complementary programming (Adamson, 2011). YPT focuses on cultivating the emotional, social and intellectual development of young people through the professional arts; deeply embedded in the philosophy of the theatre is a commitment to learning, whether it is in the classroom or at YPT.

St. Sylvester is a small, faith-based school of about 175 students in Kindergarten through to Grade 8. Located in Scarborough, Ontario, it is a school within the Toronto Catholic District School Board. In 2014, the school made a concerted effort to immerse students in inquiry-based learning. This has come about as a result of staff identifying the need to have students more engaged in their learning journey. While there has been some scepticism from the parents, given a desire for maintaining a so-called traditional style of learning, a positive impact on and response from students has been clear. The Member Schools partnership between St. Sylvester and YPT has allowed for the inquiry to deepen in various ways.

Member schools

YPT works with schools from various school boards in the Greater Toronto Area. The theatre's work with these schools ranges in scope and depth of engagement from teachers bringing their students to see a show as part of a fieldtrip to classes participating in post-show Q&As to delving into in-depth research projects about the process of play creation, production and design. Much of

this work happens by way of YPT Member Schools, a pilot program that began in 2012 with the aim of creating deeper relationships with the schools the theatre serves and making YPT programming essential to school culture. Each Member School partnership includes in its scope visits to see shows at the theatre, student and teacher workshops and learning projects delivered jointly by school and YPT staff. Something that sets the Member Schools program apart is its focus on partnership. Unlike many 'one-size fits all' programs delivered by professional arts organizations, this is a program that demands collaboration and asks teachers to work in partnership with the theatre to both design and implement the curriculum. While YPT offers different avenues for engagement, providing an expertise in theatre and learning in this particular context, much of this work is collaborative and therein lays its strength. The most successful initiatives have been created in partnership with principals and teachers engaged in this program.

METHOD

This is the third year of the Member Schools program. Since its inception, YPT staff, along with the participating teachers and principals, has been investigating the value of the programming and the impact they notice on the students and school communities. In the last year, this has focused specifically on inquiry-based learning. Assessment has been achieved by way of participatory observation, online surveys and open-ended interviews. In this way, teachers have been positioned as researchers of their own practice and, as they are every day, researchers of their students' experiences. YPT staff members have also been situated as researchers of their artistic and pedagogical practices. Member Schools has permitted YPT to further discover and refine its particular role in supporting teachers in their work.

SYMBIOTIC LEARNING

Thanks to the collaborative design and ongoing assessment of this programming, both the theatre and the schools benefit. What principals and teachers who participate in the programming find to be most valuable varies to some degree, but across the board, these are the four most important components of the programming: the quality of the art itself, the opportunity for students to learn outside of the regular classroom environment, the chance to work closely with YPT staff and artists, and the workshops that take place in connection with visits to see productions at the theatre.

The quality of the art itself

School staff says that the visits to the theatre are of the utmost importance. The shows must resonate with students and challenge them artistically and thematically in order to engage them. This program has made clear the fact that what is put on stage directly affects student learning. If the plays are not good, the learning cannot be good either. A strong example of this is the student questions and responses made through a shared online discussion in connection with a number of productions. Students articulated what the big ideas of the play were for them and what resonated with them, but most importantly, they responded with more questions about what the play made them wonder. The strength of artistic programming is what makes this learning possible.

Learning within and beyond the classroom

This helps to make the learning process continuing and engaging. Rather than fieldtrips that are disconnected from the life and work of the school, visits to the theatre become the core of longer, deeper units of study explored together. Through the leadership of their teachers who employ the theatre's study guides, workshops delivered in the classroom by YPT artist-educators and visits to the theatre, students have the opportunity to explore multiple ways of knowing (Pataray-Ching & Roberson, 2002) and to experience learning extended beyond the walls of the school. Students and teachers are able to draw inspiration from an artistic context and apply it in the school environment.

While learning outside of the classroom is invaluable, the connections made within the context of school are equally important to experiential learning. These show-connected workshops deepen the impact of the shows students see at the theatre. They also provide teachers with the opportunity for professional development in drama-based education.

YPT staff and artists

Many teachers and principals also talk about the value of the high level of access they have to YPT staff and artists. The opportunity not only for their students, but also for themselves, to learn from experts in a professional place of work is not something they can access within the walls of the school. While the programming supports student inquiry, it also fosters learning among staff at both the participating schools and YPT. YPT staff says that participating in the program has made them reflect on their responsibility as a role model, positively impacted their own practice and given them the chance to learn things about our audiences that they would not otherwise know.

CASE STUDY

One of the strongest examples of partnership in the YPT Member Schools program is St. Sylvester. This partnership privileges intellectual engagement (Willms, Friesen & Milton, 2009). The units of study are experiential and collaborative and, with support from their teachers and theatre artists, students benefit from the involvement of many stakeholders in their learning (Harada & Yoshina, 2010). Outlined below are some elements of programming that have allowed for success.

School leadership

Roy Fernandes, the principal at St. Sylvester, models and fosters inquiry professionally and personally. A good example of this comes from his blog:

> Here's the thing. I get it. I get why inquiry is so important. I'm proof. Once you tune into
>
> being a life long learner, you can't stop. I constantly have questions. I constantly want to

learn. This is new for me and was NOT part of my school life as a student. But now... I can't stop inquiring and learning. I want my children to have this problem... I want my students at school to have this problem... I want my staff to have this problem. Many are starting to both catch and spread the problem... I think I may have a problem….but I like it!"

(Fernandes, 2015)

Fernandes' commitment to learning through inquiry has increased the depth and strength of YPT programming not only at St. Sylvester, but more broadly. It has allowed YPT to emphasize an inquiry-driven methodology and experiential curriculum in their work with all schools. YPT strives for access; they aim to open the doors of the theatre wide so that young people and their teachers can learn about and be a part of the world of professional arts and, the theatre has learned, this is best done by supporting student inquiry. Fernandes' expertise has fostered learning and a deeper commitment to teaching among the YPT staff beyond the Education and Participation department.

Facilitation for artistic reflection

A strong example of this work is Fernandes' co-facilitation of the post-show discussions alongside a member of the Education and Participation department at YPT. He does this whenever his students come to the theatre to see a play. Each time this happens, there is a lot of excitement among YPT staff and visiting teachers. They are inspired to see another model of teaching and learning in the arts. For Fernandes' students, this demonstrates to them the fact that he makes arts education a priority, thus affirming their participation in it. While YPT's post-show discussions are always carefully curated, beginning with an open-ended question designed to foster further reflection and questioning, Fernandes models a particular inquiry-focused pedagogy when he facilitates these sessions which, he says, is a virtue of the artistic experience:

The essence of good theatre is precisely what YPT is able to create. I tell students that they need to engage and interact with the message. Plays such as *Blue Planet*, *Minotaur* and *Sultans of the Street* [in YPT's 2013-2014 season] were all able to establish connections with our students and this, in turn, has allowed me to engage these students in topics and themes that are sure to resonate beyond a 65-minute theatre experience. (R. Fernandes, Personal communication, November 3, 2015)

Project-based learning: Theatrical design and playwriting festival

In this partnership, engagement in inquiry happens in a more concentrated approach by way of project-based learning. For example, in November 2014, the Grade 3/4 class at at St. Sylvester participated in a learning project devoted to set and costume design in connection with the theatre's production of *James and the Giant Peach*. These students explored the story with their teacher and then learned design tools and techniques in a workshop led by designer, Robin Fisher. As a capstone to the project, they created their own designs for the show. They then visited the theatre for an in-depth backstage tour to see the designs for the production and how they have come to life on stage. During the design workshop, Robin introduced students to design by breaking the process down into steps, beginning with an idea, then a drawing, then a model, etc. She did not show them her designs, but instead solicited their ideas of what the story should look like. Students were able to practice literacy and inferencing skills and to explore visual and spatial ways of thinking. The whole class was engaged – curious, eager and full of connections and questions. Research clearly and consistently shows that when students are engaged in their learning, they are more likely to remember what they learn and will work to continue to learn independently (Bruner, 1961), moving "toward the always shifting end/goal of learning more" (Dewey, 1938, p. 34). It is clear that the teacher and school community are supporting students as active learners and developing

their curiosity across the curriculum. It was exciting for YPT to see that the design of this unit of study and approach to the workshop aligned with the vibrant pedagogy fostered at this school.

The piloting of a student Playwriting Festival has been another element contributing to the success of this programming. Engaging students in a three-month long project where they create their own short plays with the guidance of a working playwright, this festival not only allows students from St. Sylvester to explore playwriting, but to do so in collaboration with another class at a nearby Member School, St. Henry. Through careful scaffolding from the playwright, and a combination of choice, modeling, discussion and opportunity for practice, students have been engaged in the writing process in a personal way. This project exemplifies the multiple outcomes and cross-curricular interpretations permitted through theatre-based units of study.

DISCUSSION

Responsive collaboration

The continuation of collaborative programming is imperative to success. A passive partnership will not allow for progress. As mentioned earlier, a symbiotic relationship is key for there to be benefit to all participants. Schools, much like students in a classroom, will only get as much out of the Member School program as they are willing to put into it. St. Sylvester has benefitted from initiatives such as the Theatrical Design and Playwriting Festival. While these suggestions were made by the school, far more important was that YPT then took these ideas and created a valid and authentic protocol to foster inquiry – symbiotic learning at its best.

Professional development

This partnership also acts as a platform for employing signature pedagogies, "types of teaching that organize the fundamental ways in which future practitioners are educated for their new professions" (Shulman, 2005, p. 52), which strengthens the model for collaboration. The use of knowledge

building circles has been a key element in student learning, allowing students to build on what they are learning from and with each other, but what is also special about this practice is that teachers, artists and staff at the theatre now also use this tool - and other techniques – together and how, through this approach, they have become engaged more deeply in their work, leading to reflective practices and professional development. This has happened organically, but a more concentrated approach would be beneficial. Professional development delivered to the theatre's staff from expert educators, such as Fernandes, would bolster the Member Schools programming and the educative work of YPT more broadly.

Further research

Findings from a year of inquiry-based learning demonstrate that theatre can provide a springboard for experiential inquiry-based learning and can increase the possibility of helping students to immerse themselves in the learning process and become active in that journey. There is little research on learning in the context of the professional arts that is focused on this specifically. With regard to this particular project, much of the assessment is anecdotal, focused on student learning and program design. Furthermore, it does not include students as primary participants. There is need for research that works to understand young people's reflections of their own learning experience.

CONCLUSION

This partnership supports the development of best practices in arts education:

> Theatre programs are committed to high levels of achievement in a curriculum that supports intentional learning through high impact pedagogical strategies. Active, rather than passive, learning encourages students to become intentional learners... knowledge becomes practical, something that is essential to theatre practitioners creating informed and

responsible interpretations… They work with complex ideas, and through multiple systems

of knowing (interdisciplinary investigation and integration of information), they cultivate

the ability to share findings with others involved in the production. (Kindelan, 2012, p. 92)

The partnership between YPT and St. Sylvester is a strong example of inquiry-based teaching and

learning through professional theatre. It provides a model for partnership in the context of the

professional arts. For its continued success, a concentrated approach that includes collaborative

and responsive programming, ongoing professional development and rigorous research is crucial.

REFERENCES

Adamson, L. (2011). *Why bring students to the theatre? An exploration of the value of*

professional theatre for children. Retrieved from

http://tspace.library.utoronto.ca/bitstream/1807/30062/3/Adamson_Lois_EW_201111_M

A_thesis.pdf

Bruner, J. (1961). The act of discovery. *Harvard Educational Review*. *31*, 22-32.

Dewey, J. (1938). *Experience and education*. New York, NY: Simon and Schuster.

Fernandes, R. (2015, March 6). I think I have a problem. *Inquiring minds=life-long learners*.

Retrieved from https://inquirenlearn.wordpress.com/2015/03/06/i-think-i-have-a-problem/

Harada, V. H., & Yoshina, J.M. (2004). *Inquiry learning through librarian teacher*

partnerships. Columbus, Ohio: Linworth Publishing, Inc.

Kindelan, N. (2012). *Artistic literacy: theatre studies and a contemporary liberal education*.

New York, NY: Palgrave Macmillan.

Pataray-Ching, J., & Roberson, M. (2002). Misconceptions about curriculum-as-inquiry

framework. *Language Arts*, 79, 498– 505.

Pitman, W. (1998). Learning the arts in an age of uncertainty. North York: Arts Education

   Council of Ontario.

Schonmann, S. (2007) *Theatre as a medium for children and young people: images and*

   observations. Dordrecht: Springer.

Shulman, L. (2005). Signature pedagogies in the professions. *American Academy of Arts &*

   Sciences, 134(3), 52-59.

Willms, J.D., Friesen, S., & Milton P. (2009). *What did you do in school today? Transforming*

   classrooms through social, academic, and intellectual engagement. Toronto: Canadian

   Education Association. Retrieved from

   http://www.cea-ace.ca/sites/default/files/cea-2009-wdydist.pdf

THE USE OF BLOGS AND FACE-TO-FACE INTERACTIONS TO DEVELOP INTERCULTURAL COMPETENCE

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In today's global world, the acquisition of intercultural competence (ICC) is essential for effective communication and interaction. Study Abroad Programs provides students the opportunity to immerse themselves in a new culture, learn a new language and increase ICC; however, ICC attributes are necessarily acquired through formal education. This paper is an in-depth literature review and analysis of empirical studies that looks at face-to-face (FtF) interactions and blogs to foster ICC in second language adult learners who are enrolled in study abroad programs.

Keywords: Blogs; Study abroad; English as a Second Language; Face-to-face interactions; Intercultural competence; Intercultural education

INTRODUCTION

Partaking in study abroad programs certainly presents opportunities to develop adult learners' intercultural competence (ICC). However, it is not necessarily the case that ICC can be acquired through cultural immersion or language learning. Instructors in study abroad programs play a pivotal role to facilitate ICC by providing support and guidance when integrating experiential approaches, such as blogs and face-to-face (FtF) interactions into their curriculum. Although the concept of ICC and the need for intercultural education have been advocated by theorists and educators for over five decades, there remains a gap between theory and practice (Bryam as cited in Porto, 2013). ICC is often seen as an

essential goal of language teaching but there is a lack of attention to students' development of ICC in most language teaching programs (Godwin-Jones, 2013; Porto, 2013). The absence of intercultural education could be due to instructors' lack of ICC and many feel that fulfilling linguistic goals is more important than inculcating ICC (Dytynyshyn & Collins, 2012; Godwin-Jones, 2013). Byram argues that ICC is not an easy construct to measure in the language teaching context. Nonetheless, ICC has become increasingly important in today's global society and educators should recognize the importance of their role in designing and facilitating activities to foster students' ICC.

BLOGS AND FACE-TO-FACE INTERACTIONS

Similar to other educational programs, second language educators are increasingly incorporating the use of web 2.0 tools and social media tools such as Facebook, wiki and blogs into their contexts. In this article, we reviewed and analyzed empirical studies that have used blogs and FtF interactions to foster ICC in study abroad contexts. Blogs offer students the opportunity to communicate with wide variety of authentic online and provides a platform for the learners to reflect and gain knowledge about their own and other cultures. According to Godwin-Jones (2013), the individualized expression of a journal or blog can be a liberating experience because it allows students to both explore cultural insights and experiment with the target language.

The value of personal FtF interactions should not be underestimated, especially in a multi-ethnic classroom where people from various backgrounds come together to learn a language (Dytynyshyn & Collins, 2012). Students who are registered in immersion programs also have the opportunity to interact with native speakers and people from other cultures in real-life settings. Many would argue that FtF interactions have an advantage over digital technologies because one is able to

interpret verbal and non-verbal cues more readily. However, educators can take advantage of the benefits of both technology and traditional FtF interactions, by using them in tandem.

In the studies that have been conducted on the use of blogs in study abroad contexts, there were increases in ICC attributes such as increased cultural awareness and knowledge, changes in perspectives and attitudes, and increased appreciation and understanding of other cultures (Elola, & Oskoz, 2008; Lee, 2011; Urlaub; 2011). However, the content of the blogs in those studies was rather superficial. Other common issues were technological problems and accessibility to technology. For example, students wanted to contribute more to blogs but did not have access to a computer all the time. In regards to FtF interactions, Lee (2011) and Doyle, Helms, and Westrup (2004) found that students' cultural knowledge and awareness increased from interviewing native speakers in real-life settings. Dytynyshyn and Collins (2012) have found that students were able to develop trust (an important ICC attribute) with one another and with the instructor. In both the blogs and the FtF studies, the critical role of the educator was highlighted throughout the intercultural learning process. However, while these studies did provide us with insights and ideas on effective approaches to developing ICC, the generalizability of their studies was limited by small sample sizes.

This paper is an in-depth literature review and analysis of empirical studies that examined incorporating blogs and face-to-face (FtF) interactions to foster ICC in second language adult learners who are enrolled in study abroad programs.

Objectives of enquiry

The purpose for this enquiry is to add to the body of literature on using blogs and face-to-face interactions to develop adult learners' ICC in adult ESL programs. The following questions are

posed: (1) How do blogs help develop adult learners' intercultural competence in education abroad programs (i.e., ESL programs)? (2) How do face-to -face interactions help develop adult learners' intercultural competence in education abroad programs (i.e., ESL programs)?

A CRITICAL REVIEW OF THE LITERATURE ON INTERCULTURAL COMPETENCE AND INTERCULTURAL EDUCATION

According to Deardorff's (2006) study on the definition and concept of ICC, ICC is an individual's ability to interact effectively with people from different cultures. The four components typically seen in many definitions of ICC are knowledge, attitudes, skills and actions (Byram, Gribkova & Starkey, 2002). While it is possible to acquire ICC attributes on one's own, through information education, intercultural learning is more effective when facilitated by trained instructors (Paige & Goode, 2009). Students benefit from formal intercultural education (Bennett, 2011; Byram, 2009; Paige & Goode, 2009) and instructors should take a cultural mentoring role (Paige & Goode, 2009). However, ICC training in the classroom is still often non-existent or minimal. Paige and Goode (2009) believe that the responsibility lies with institutions and hiring managers, to ensure that instructors are provided with opportunities to understand the concept of ICC and how to promote and facilitate cultural learning.

Developing intercultural competence through blogs and face-to-face interactions

Both blogs and FtF interactions promote experiential, active, collaborative and student-centred learning, aligning with objectives of many educators today. Blogs are one type of many other Web 2.0 platforms that are used in one's personal lives, professional lives and in educational contexts. Blogs are becoming increasingly popular in study abroad contexts as they offer an authentic

audience and allow students to become owners and developers of their own website. Blogs also enables the building of a community of people who are interested in similar topics.

The use of FtF interactions have also been recommended and promoted by numerous scholars, and organizations. The Alberta Teachers of English as a Second Language [ATESL], (2009) is one example of a local association that recognizes the importance of intercultural education by including it as part of their curriculum framework. Recommendations to integrate technology and FtF interactions into English as Second Language (ESL) contexts are put forth in their list of best practices (ATESL, 2009).

Studies that have looked at blogs as reflective journals and blogs for collaborating, sharing and searching for information have revealed positive results in fostering students' ICC. Blogs were an effective method to help students develop their ICC. The use of blogs have enabled them to gain better understanding and appreciation of the target culture and their own culture (Ducate & Lomicka, 2005; Elola & Oskoz, 2008; Lee; 2011; Urlaub, 2011). Changes in attitudes towards one's own and other cultures were also found in those studies (Elola & Oskoz, 2008; Lee, 2011; Urlaub, 2011). However, while it was evident that the blogs afforded students to gain more cultural knowledge and provide them with opportunities to reflect deeper about the target culture and their own, the findings were not all positive. A recurring issue in many studies was the lack of depth in the blogs. Students might not know what to write, how to reflect or how blogs worked. For instance, students in Lee's (2011) study requested more guidance in how to use the blogs and once the teacher intervened and provided more z guidance; students began to show more depth in their comments.

Furthermore, while Urlaub's (2011) case study was a tellecollaboration study, the one participant who was going to study abroad had the opportunity to meet the at-home students in a traditional face-to-face environment before studying abroad. It has provided opportunities for the participants to develop trust and friendship, which was likely to make them feel more comfortable with one another. It could be argued that Urlaub's participants felt more comfortable sharing information with their peers as they had gotten to know one another face-to-face and accompanied with teacher facilitation and guidance. This could have had a positive impact on the participants' depth of the comments and reflections.

The instructor plays a pivotal role to facilitate blogs. While it is easy to assume that students are familiar with all types of technology and should know how to blog, it is evident that they still need training, facilitation and guidance throughout the process. Many of the studies on blogs have used small sample sizes and lasted over a short duration of time. Doyle et al. (2004) examined the impact of both experiential learning and FtF cultural-focused scavenger hunts on the cultural awareness of students who registered in a nine-day study abroad business program. Students were found to be able to ask native speaker's questions and it has increased their cultural awareness. Dytynyshyn and Collin's study (2012) investigated the instructor's role in developing ESL student's ICC in a multi-ethnic ESL class. They found that the instructor introduced activities that encouraged direct contact. As a result, it was able to promote relationships, trust and sharing, essentially in developing critical aspects of students' ICC. It was argued that the instructor was most likely interculturally competent herself, which most likely had a direct effect on the results. While the results from these studies have provided us with some insights, there were a number of limitations associated with these studies, which makes it difficult to make generalizations and replicate these studies. For instance, Dytynyshyn and Collins (2012) acknowledged that having

only one researcher decreased the reliability of their study. It was not an ethnographic study but rather based on the observations by the sole instructor might have increased the chances of bias. Additionally, Doyle, Helms, and Westrup's (2004) study was only nine days and the researchers did not seem to reveal much information or analysis about the experiences of the participants.

CONCLUSION

This review and analysis of the literature revealed that blogs and FtF interactions can serve as effective tools to foster students' ICC in study abroad contexts. However, it was evident that technological platforms such as blogs are simply tools and challenges are bound to arise. These challenges include accessibility to technology and quality of postings (e.g., lack of depth in content). Furthermore, many of the studies were limited in their generalizability due to small sample sizes and short duration of studies. Hence, future research should include using larger samples sizes over a longer period of time to increase generalizability. We also need to be able to replicate these studies.

Instructors in study abroad programs need to continue working together with students to help develop their ICC. The ability to recognize that immersion, cultural knowledge, or language learning does not necessarily lead to the development of adult learners' ICC, thus highlighting the importance of formal intercultural education through the use of mediums such as blogs and FtF interactions. However, preparing these activities and supporting students throughout the process will take a lot of time, mentoring, and guidance. It is important for higher education institutions to ensure that instructors who teach in study abroad programs are provided with support, guidance and proper training.

REFERENCES

Alberta Teachers of English as a Second Language (ATESL). (2009). *Best practices for adult ESL and LINC programming in Alberta*. Retrieved from http://www.atesldocuments.com/cf/sites/default/files/downloads/Introduction.pdf

Bennett, M.J. (2006). Defining, measuring, and facilitating intercultural learning: A conceptual introduction to the intercultural education double supplement. *Intercultural Education*, 20(4), 1-13. doi:10.1080/14675980903370763

Bryam, M. (2009). Intercultural competence in foreign languages. The intercultural speaker and the pedagogy of foreign language education. In D. Deardorff (Ed.), *The Sage Handbook of Intercultural Competence* (pp.321-331). Thousand Oaks, California: Sage Publications.

Byram, M., Gribkova, B., Starkey, H. (2002). *Developing the intercultural dimension in language teaching. A practical introduction for teachers*. Strasbourg: Council of Europe

Deardorff, D.K. (2006). Identification and assessment of intercultural competence as a student outcome of internationalization. *Journal of Studies in Intercultural Education, 10*, 241-266. doi: 10.1177/1028315306287002

Doyle, M., Helms, M. & Westrup, N. (2004). A fast track to cultural immersion. *Journal of Teaching in International Business*, 15(4), 67-95. doi: 10.1300/JO66v15n04_05

Ducate, L. & Lomika, L. (2005). Exploring the blogosphere: use of web logs in the foreign language classroom. *Foreign Language Annals*, 38(3), 410-420. doi: 10.1111/j.1944-9720.2005.tb02227.x

Dytynyshyn, N. & Collins, L. (2012). The adult ESL context in urban Quebec: a look at culture and interculturality. *TESL Canada*, *30 (1)*, 46-68. Retrieved from http://www.teslcanadajournal.ca/index.php/tesl/article/view/1125/944

Elola, I. & Oskoz, A. (2008). Blogging: fostering intercultural competence development in foreign language and study abroad contexts. *Foreign Language Annals, 41(3)*, 454-477. doi: 10.1111/j.1944-9720.2008.tb03307.x

Godwin-Jones, R. (2013). Integrating intercultural competence into language learning through technology. *Language Learning & Technology, 17(2)*, 1-11. Retrieved from http://llt.msu.edu/issues/june2013/emerging.pdf

Lee, L. (2011). Blogging: promoting learner autonomy and intercultural competence through study abroad. *Language Learning & Technology, 15 (3)*, 87-109. Retrieved from http://llt.msu.edu/issues/october2011/lee.pdf

Porto, M. (2013). Language and intercultural education: an interview with Michael Byram. Pedagogies: *An International Journal*, *8(2)*, 143-162. doi:10.1080/1554480X.2013.769196

Paige, M. & Goode, M. (2009). Intercultural competence in international educational administration, cultural mentoring. In D.K.Deardorff (Eds.), *The Sage Handbook of Intercultural Competence* (pp. 321-337). Thousand Oaks, California: Sage Publications Inc.

Perry,L.B. & Southwell, L. (2011). Developing intercultural understanding and skills: models and approaches. *Intercultural Education, 22(2)*, 453-466. doi:10.1080/14675986.2011.644948

Urlaub, P. (2011). Intercultural blogs in study-abroad contexts. *Academic Exchange Quarterly, 15 (3)*, 43-50.

Van de Vijver, F. & Leung, K. (2009). Methodological issues in researching intercultural competence. In D. K. Deardorff (Eds.), *The Sage Handbook of Intercultural Competence* (pp. 404-418). Thousand Oaks, California: Sage Publications Ltd.

Wang, S. & Vasquez, C. (2012). Web 2.0 and second language learning: what does the research tell us? *CALICO Journal*, *29 (3),* 412-430. Retrieved from

http://journals.sfu.ca/CALICO/index.php/calico/article/viewFile/25/35

THE AFFORDANCES OF VARIATION THEORY (NEW PHENOMENOGRAPHY) IN ENHANCING EAL STUDENTS' LEARNING

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Variation theory is relatively new perspective on learning and has not been comprehensively explored in the English as an additional language (EAL) context. Research in other educational fields has shown that lesson structures informed by variation theory have been able to enhance student learning. This paper is an attempt to demonstrate how lesson structures guided by variation theory can be applied to teaching vocabulary. An analysis of the lesson presented suggests that using variation theory in an EAL context provides affordances that increases the probably of student learning, and merits further investigation.

Keywords: Variation theory; English language teaching; Teaching vocabulary

INTRODUCTION

This paper is an attempt to demonstrate how *variation theory* (Marton & Booth, 1997) can indeed be a source of pedagogical principals that inform teaching vocabulary in an English as an additional language (EAL) context. The motivation behind exploring lesson structures informed by variation theory arises from my personal experience employing it in mathematics education, as well as research, which report successful learning in mathematics (Runesson, 2005; Watson &

Mason, 2006), teaching writing in Chinese as a second language (Marton & Tsui, 2004), and teaching writing and grammar in ESL (Ling Lo, 2012). After a brief and limited description of variation theory, I present two lessons focusing on the verb "get," one informed by the communicative approach, and the other, by variation theory. I provide an analysis of these lessons and show how the implementation of variation theory can structure learners' awareness, which increase the probability of learning.

WHAT IS VARIATION THEORY?

Variation theory is a perspective on learning and experience that explains how a learner might come to see, understand, or experience a phenomenon in a particular manner. Variation theory is rooted in phenomenography, which focuses on describing and discovering variation in the ways people experience a particular phenomenon. Variation theory, however, focuses on explaining why the variations in experience exist. The theory has pedagogical implications, which aim to enhance learning.

What is learning?

Because our brain has a limited capacity for processing information, when we experience a phenomenon, it is impossible to attend to every aspect of that phenomenon simultaneously. Consequently, some aspects of the phenomenon come into our focal awareness while other aspects fade into the background. Therefore, what we experience depends on which aspects of the phenomenon we can discern simultaneously. In other words, if two learners attend to different aspects of the same phenomenon, they will experience that phenomenon in different ways. However, if we help learners structure their awareness so that they are able to discern particular aspects of a phenomenon at the same time, the probability of learning increases.

Three key concepts underlie learning in variation theory: Discernment, variation, and simultaneity. According to variation theory, all three concepts are essential for learning. In order for learners to experience a phenomenon in the intended way, they would need to discern critical features. For example, a critical feature of the concept of a ripe tomato is the "redness" of the tomato. Therefore, teaching this concept involves learners experiencing variation in the dimensions of colour so as to discern redness. If learners are unable to discern redness while trying to understand the concept of a ripe tomato - perhaps because the pictures we show them are in black-and-white - we have not structured the learners' awareness to experience the phenomenon of a ripe tomato in the intended way. It is important to point out, however, that discernment is not possible without variation. If everything in the world were red, the concept of redness would have no meaning because we would have nothing to compare to. We can understand red because we can compare to "blue", "green", and "yellow." It is not enough, however, to simply tell the students what the critical aspects of a particular phenomenon are. Learning occurs when learners experienced a variation in the dimensions of the critical aspects – first individually, then collectively and simultaneously.

Everything has a multitude of features. Therefore, if we want learners to see an object in exactly the same way, then we must be able to focus their attention on the same features in the same order. These aspects of an object or a phenomenon which are necessary for a particular meaning to appear in learners' awareness are known as *critical features*. In a learning environment, the teacher, or the resource usually selects critical features of whatever it is to be learned. Critical features cannot be selected without first identifying the *object of learning*. In variation theory, the object of learning is a "specific insight, scale or capability that the students are expected to develop" (Marton & Pang, 2010, p. 2).

USING VARIATION THEORY IN TEACHING VOCABULARY

In this section, I will present two different types of lesson structures (Lesson A and Lesson B) focusing verb phrases with get as head. We will assume that this lesson is meant for intermediate EAL learners who have had prior exposure to the different usages of "get." The structure of Lesson A is informed by the communicative approach, while Lesson B is inspired by variation theory. There are three objects of learning. The first object of learning is realization that the verb get has multiple meanings. The second object of learning is the understanding that combining get with a particle (preposition or adverb) constructs a phrasal verb. The third object of learning is that phrasal verbs (with get as head) with the same components have different meanings.

Lesson A

The teacher begins the lesson by presenting a table (see Table 1) with two columns. The first column contains four sentences in which the head of the verb phrase is get. The synonyms/definitions of the verb phrases are written in the second column, but they do not correspond in sequence with the sentences in first column.

Examples	Synonyms
We usually **get** home around 5 in the afternoon.	Have a good relationship
She can **get round** the problem if she listens to me	Arrive
I don't **get on** well with my sister.	Become
Education **gets** more and more expensive every year.	Solve

Table 1: Examples for different uses of get.

The teacher then instructs her students to match synonyms/definitions of the second column to the sentences in the first column. Next, she randomly asked four students to read the answers so that

everyone else can check theirs. She then explains that get can have different meanings such as arrive or become.

In the next section, the teacher provides her students with a set of questions (see Table 2) and asks them to mingle by walking around the class interviewing as many people as they can. After about 10 minutes, the teacher asks the students to get into pairs and write statements about the persons they interviewed using get. Finally, the teacher asked students to read some of their sentences. Everyone in the class gets a chance to contribute.

No.	Questions
1	Do you have a good relationship with your parents?
2	Who usually helps you solve your problems?
3	Do you usually arrive at work on time?
4	Are you worried about aging?

Table 2. Questions given to students in Lesson A.

The teacher then writes "get on," and "get round" on the whiteboard and explains that get can combine with particles (prepositions or adverbs) to make phrasal verbs. Next, she writes "get through," and "get over" on the whiteboard. She then explains that each phrasal verb can have three different meanings. She asks students to get into pairs and look up the different meanings using their dictionaries and then write their own sentences as examples for each of the phrases. When the task is complete, students share their answers.

Lesson B

This lesson is divided into interrelated episodes, each focusing an object of learning described above. In Episode 1, the teachers remind the students that the verb, get, has multiple meanings. She

introduces two pairs of sentences one by one (see Table 3). Each pair is identical except for their

verb phrase (VP). She reads the sentences slightly raising her voice when she reads the verbs. She

then points to the verbs in bold and explains that get can mean, "arrive" or "become."

Sequence	Sentence A	Sentence B
1	My dad **gets** home from work in the evening on Wednesdays.	My dad **arrives** home from work in the evening on Wednesdays
2	My dad **gets** tired from work in the evening on Wednesdays.	My dad **becomes** tried from work in the evening on Wednesday.

Table 3: Examples for two definitions of get.

In Episode 2, the teacher presents three sentences (see Table 4) the first two together then the third,

again identical expect for verb phrases. The second sentence she presents is combination of get and

a preposition. The teacher asks the students if they see any deference in verb structure between the

first and second sentence. The students recognize the get + "on" structure in the second sentence.

The teacher then reminds the student that verb + preposition is called a phrasal verb, and that ones

with get as head are quite common. Next, she presents the third sentence, which has a verb-adverb

combination. The teacher asks how the third sentence is different form the second sentence. The

students recognize the verb + adverb structure. The teacher then prompts that this structure is a

phrasal verb and phrasal verbs with get as head are also common.

Sequence	Sentence A
1	My dad can **get** annoyed with some people at work.
2	My dad can **get on** with some people at work.
3	My dad can **get round** some people, at work.

Table 4: Possible verb structures with the get.

In Episode 3, the teacher presents two sequences of sentences (see Table 5). Sentence A in Sequences 1 and 2 uses the same phrasal verbs (get on), but does not have identical verb phrases. Sentences B in Sequences 1 and 2, are identical except that they have two different verb phrases that reflect the different definitions of get on. The teacher asks the students to read the sentences, then points out that the same prepositions paired with get can have have different meanings. She then explains definitions of "get on".

Sequence	Sentence A	Sentence B
1	We often don't **get on** at work because of his need to interrupt people.	We often don't **have a good relationship** at work because of his need to interrupt people.
2	We often can't **get on** working because of his need to interrupt people.	We often can't **continue** working because of his need to interrupt people.

Table 5. Examples of get on with different definitions.

In Episode 4, the teacher then presents two other sequences. Sentence A in Sequences 1 and 2 have adverbial phrasal verbs. Sentence B in Sequence 1 and 2 have different verbal phrases to reflect the different meanings of the phrasal verbs. Following the same procedure as before, she explains that not only phrasal verbs containing get and an adverb can have different meanings, but phrasal verbs with the same head and particle (e.g. get round) can also have multiple meanings. Table 6 displays the pair of sentences she uses for this sequence.

Sequence	Sentence A	Sentence B
1	She can **get round** him with the right attitude.	She can **persuade** him with the right attitude.
2	She can **get round** the problem with	She can **solve** the problem with the right

the right attitude.	attitude.

Table 6. Examples of get round with different definitions.

In Episode 5, the teacher provides the students a set of questions (See Table 7), and asked them to complete two small tasks. First they are to get into pairs and identify the meanings of the verbs or phrasal verbs in the questions. Second, they are to mingle with other students with the aim of interviewing as many students as they can with the questions provided.

No.	Questions
1	Do you get on well with you parents/children?
2	What time do you usually get home from work/school?
3	How do you get round the traffic problem?

Table 7: Question given the students in Lesson B.

In Episode 6, the teacher asks students to report on their interview by making statements about their interviewees using the verb get. For the next task, the teacher informs her students that "get through" and "get on" each have at least two other meetings. The students are to find other meetings for the phrasal verbs (by using their dictionaries) and create question similar to the ones in the previous task.

Finally in Episode 7, the teacher asks two student volunteers to write their questions for the different meanings of the phrasal verbs (get through and get on) on the board. Next, she asks them to read the questions and explain the different meanings of the phrasal verbs. Finally, she asks for volunteers to reconstruct the questions on the board by using an expression that carries the meaning of the phrasal verb.

ANALYSIS OF THE LESSONS

Using patterns of variation is a useful tool that improves the possibility of achieving the object of learning. According to variation theory, whether the object of learning is achieved hinge on whether the students experience the pattern of variation, which allow for discernment of the critical features. Both lessons described above were structured considering the three objects of learning. Moreover, communicative (i.e. interviews) and skilled-based activities (i.e. using the dictionary to find multiple definitions) were part of both lesson structures. However, in Lesson A, the teacher directly told the students what the critical features were. In Lesson B, the students were given the opportunity to discerned the critical features, by being presented with two identical sentences (Episodes 1-4) expect for the verb phrase. These patterns of variation (see Table 8, note that NP is an acronym for noun phrase and PP is an acronym of prepositional phrase) structure the students' attention on what is varied, which, according to variation theory, increases the probability of discernment of the critical features. Episodes 5 to 7 allow students to experience simultaneity of the critical features.

	Invariant	Varied	Critical feature to be discerned
Episode 1	NP, PP,	VP	The verb get has multiple meanings.
Episode 2	NP, PP	VP	Get + preposition is a phrasal verb
	NP, PP	VP	Get + adverb is a phrasal verb
Episode 3	NP, PP,	VP	Get + same preposition has multiple meanings
Episode 4	NP, PP,	VP	Get + same adverb has multiple meanings

Table 8: Patterns of variation in Lesson B.

CONCLUSION

Applying variation theory is a good example of responsive pedagogy, as it affords flexibility in patterns of variation to address students' misunderstandings. That said, although variation theory

offers exciting prospects in the field English language teaching, it is not presented here as a panacea for all teaching contexts. Variation theory is a new perspective and the lesson described above has not been implemented in a real context. Therefore, it is difficult to discuss its possible advantages and shortcomings. However, structuring a lesson so as to encourage teachers and students to identify the critical features of an object of learning though comparison with existing frameworks of knowledge and understanding is, in my opinion, worthy of further exploration.

REFERENCES

Ling Lo, M. (2012). *Variation Theory and the improvement of teaching and learning*. Gothenburg, Sweden: Acta universitatis Gothoburgensis.

Marton, F., & Booth, S. (1997). *Learning and Awareness*. NY, New York: Routledge.

Marton, F., & Pang, M. (2010, December, 2014). *Connecting student learning and classroom teaching through the variation framework*. Paper presented at the 12th Conference of the European Association for Research on Learning and Instruction., Budapest, Hungary.

Marton, F., & Tsui, A. B. M. (2004). *Classroom discourse and the space of learning*. Mahwah, NJ: Lawrence Erlbaum Associates.

Runesson, U. (2005). Beyond discourse and interaction. Variation: a critical aspect for teaching and learning mathematics. *Cambridge Journal of Education, 35*(1), 69-87.

Watson, A., & Mason, J. (2006). Seeing an exercise as a single mathematical object: Using variation to structure sense-making. *Mathematical Thinking and Learning, 8*(2), 91-111.

COMPARATIVE PERSPECTIVES ON CHEMISTRY TEACHING AND LEARNING IN HIGHER EDUCATION

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Science learning in higher education has been examined in light of the cognitivist and constructivist theories of learning and ways in which these theories can inform teaching practices. Science teaching practices have been studied from developmental and pedagogical content knowledge perspectives. This paper provides a review of seminal and recent literature on research advances in chemistry education, and the application of constructivist learning theories to teaching and learning.

Keywords: Chemistry; Higher education; Constructivism

INTRODUCTION

The understanding of the sciences often involves learning barriers that include difficulty in the comprehension of abstract concepts. Teaching and learning of scientific concepts are reported as very challenging for both teachers and students due to the misconceptions formed by students, which could be due to ineffective teaching practices, confusing statements provided in textbooks, or gaps in their prior knowledge base (Johnstone, 1991). Students often find it difficult to think critically and apply knowledge towards problem solving (Gabel, 1999). There have been numerous studies in the past that have focused on how the learning of science occurs and how this

knowledge about learning can be effectively utilized to facilitate instruction (Cooper & Sandi-Urena, 2009; Johnstone, 1997; Osborne, 1996; Rickey & Stacy, 2000).

MISCONCEPTIONS IN SCIENCE LEARNING

Chemistry learning often involves representation of concepts at three levels: macro (physical), sub-micro (particulate) and symbolic (including the the use of mathematical symbols, formulae, and equations) (Johnstone, 1991). Building on Bruner's (1966) three-stage model of knowledge representation, Lin (2015) suggested that teachers can support learners through designing phased activities: (1) enactive activities (where learners benefit from engaging in physical tasks), (2) iconic activities (where learners benefit from engaging with visual representations), and (3) symbolic activities (where learners are ready to work with abstract terms and symbol systems). Mahaffy (2004) added the *human influence* component to the above three-component representation, modifying it to a four-component tetrahedral representation. He asserted that teaching and learning of chemistry depends upon diverse influences of society and the living environment that surrounds us. The inadvertent switching of concepts from one level to the other by teachers makes it difficult for students to connect the three levels in order to completely understand the concept. When chemistry teachers do not understand the stages/levels of students' understandings that they need to support, students' understandings of concepts can be limited to the surface features of the macroscopic representation, such as color and appearance of a chemical substance (Weerawardhana, Ferry, & Brown, 2006). Students often also find chemistry principles and chemicals as alien to their everyday lives (Gabel, 1999). Another barrier to learning is the use of language during instruction, which if not used carefully, can mislead the students (Gabel, 1999). If the structure of curriculum in textbooks is inappropriately sequenced to support student learning, curriculum can become a roadblock for newcomer students (Gabel, 1999). Sometimes, curriculum

overload can be an extrinsic motivator for students, which can cause them to follow surface approach to learning. While students who achieve surface learning can do well in exams, there is little evidence of meaningful conceptual learning (Pratt, 1998).

In order to build a comprehensive understanding of student learning barriers and to come up with effective strategies in dealing with them, viewpoints of both science education researchers and learning theorists need to be considered. The following sections provide review of research on constructivist theories of learning and teaching practices based on the developmental perspective on teaching. An account on research from science education has been provided along with these theories and perspectives of theorists and science education researchers have been correlated in the present context of addressing student learning barriers.

PRIOR KNOWLEDGE: CONSTRUCTIVIST THEORIES OF LEARNING

Cognitivist and constructivist theorists argue that teaching and learning are not synonymous (Ormrod, 1995). Both cognitivist and constructivist learning theories emphasize the role of prior knowledge and experiences as fundamental structures on which further knowledge is built (von Glasersfeld, 1984). Constructivist theories of learning focus more on social processes involved in constructing new knowledge through interdependent interactions among learners and teachers that include engagements with learning resources and physical artifacts within designed social learning activities (Parchoma, 2015).

The constructivist approach focuses on "reflection on experience" (Fenwick, 2003, p. 22) and it is only when learners are able to critically reflect upon their prior learning experiences and connect their new knowledge to those experiences, can they construct new understandings. Constructivists view learning as an active process where learners construct knowledge, rather than passively absorbing it (Fox, 2001). Knowledge is also considered to be a personal and idiosyncratic process

(Fox, 2001). Teachers can work as facilitators of reflection and have the students be involved in learning tasks that provide opportunities for critical reflection (Fenwick, 2003).

As learners confront new ideas, they try to fit it into their existing schema and if there is a mismatch, they try to either modify an existing understanding or create a new one. Sheckley and Bell (2006) suggested that the process of reflection involves reinterpreting the past experiences in light of new experiences. When new experiences do not fit the patterns that already exist, brain makes meaning of these experiences by making new connections from an alternate perspective. Mezirow (1990) describes this experience as a *disorienting dilemma*.

The constructivist theories elucidate why misconceptions formed by science students are resistant to instruction (Bodner, 1986). When new knowledge presented to the students doesn't fit with their prior experiences, they try to replace a misconception by constructing a new concept that explains their experiences in a better way. Unless the misconceptions are dealt by constructing new concepts, no amount of instruction can help students change their conceptualizations.

The social constructivist models consider that learners construct new knowledge by reflecting and building upon their previous understanding through social interaction. Social constructivism has established a strong foundation for *mathematics and science education* (Atwater, 1996) and offers practical strategies for addressing student misconceptions (Osborne, 1996). Participating in group discussion plays an important role in increasing student capacity to test ideas, analyze others' ideas and build a deeper understanding of their learning (Nystrand, 1996; Wieman, 2007). Social interaction also increases self-regulation, motivation, collaborative skills and the problem-solving abilities (Matsumura, Slater, & Crosson, 2008).

According to Novak (2010), multicultural science education involves five elements in the education process: science learner, science teacher, science curriculum, context or social milieu of

the science classroom and evaluation of these elements. Keeping these elements in mind, it is apparent that the process of learning is idiosyncratic for each individual, and therefore, there needs to be a negotiation of meaning between the teacher and students and also amongst students for meaningful learning to occur.

The social constructivist theories fit well with the teaching and learning of science and learning in a social context is an important element of meaningful scientific learning. Meaningful learning involves both implicit and explicit learning processes (Vygotsky, 1986). The implicit learning process involves embodiment of knowledge after making interpretations from the social environment without mindful reflection. The explicit learning process, on the other hand, includes interaction with others through dialogue, brainstorming, and discussion, and through these processes, the activation of prior knowledge takes place.

SCIENCE INSTRUCTION: THE DEVELOPMENTAL PERSPECTIVE

The developmental perspective is the "emergent dominant perspective" (Pratt, 1998, p. 45) in North American education system today, particularly in the area of *science education*. The developmental perspective fits well with the constructivist learning approaches (Candy, 1991). Both perspectives value prior knowledge as a foundation on which new knowledge is built and argue that it is necessary to activate learners' prior knowledge in order to support them in constructing new knowledge. Touching upon the concept of Vygotsky's (1978) zone of proximal development (ZPD), Pratt (1998) suggested that teachers should start their instruction from the students' ZPD, so that instruction is neither too simple nor too challenging for the students. ZPD is the activity zone in which learners cannot demonstrate their knowledge by means of their own capacity but can only do that with support. Vygotsky (1986) emphasized that student's learning is limited by their proficiency in what they already know and development of knowledge beyond this

zone requires interpersonal interaction, scaffolding and mindful delivering of information by the teacher. Effective instruction demands that no assumptions should be made about learners' prior understanding; rather the learners should be given an opportunity to express what they already know.

Within the developmental perspective, teachers act as *mentors*, who challenge students to find answers to their questions (Pratt, 1998). Students share control with the mentor, collaboratively negotiating the effectiveness of the teaching practice and their experiences. The intention of the mentors is to provide the learners with more questions than answers. It is assumed that teaching from this perspective takes place in a safe environment where the learners are encouraged to express their thoughts freely and the teachers refrain from criticizing and judging the students. If, on the contrary, students are confronted frequently with their shortfalls, the great ideas that they come up with will die out even before being born. In such a scenario where the students' self-esteem is challenged, there is indeed no learning as the focus shifts from gaining knowledge to preserving one's self-esteem (Whitman, 1990).

Pedagogical content knowledge

Other than mastering the content and gaining knowledge on effective teaching strategies for dealing with student misconceptions, teachers need to attain proficiency in the pedagogical content knowledge (PCK), which is defined as the knowledge about the teaching and learning of a particular subject that takes into account the specific intrinsic learning demands of the discipline (Shulman, 1986). Likewise, Pratt (1998) defined PCK as the "bridging knowledge" (p. 134). Pratt highlighted that teachers often try to gain expertise in the subject matter (content expertise) and the general principles of teaching (process expertise); however bridging knowledge involves transforming the content for teaching purposes. PCK includes both content knowledge

(understanding of the subject matter) and pedagogical knowledge (understanding of the teaching and learning processes independent of the subject matter). Bucat (2004) commented that the accumulated PCK of teachers "grows with experience, peaks at retirement and then disappears" (p. 225) without contributing much to the common shared understanding of the teaching profession, which he calls *professional amnesia*. This situation thus calls for the application of PCK in the classroom and the need for research studies in the area of PCK that can illuminate content-specific knowledge and teaching strategies amongst the scientific community (Bucat, 2004).

CONCLUSIONS

Peer reviewed literature on constructivist learning theory and science education research shows compelling evidence suggesting that prior knowledge is paramount in the learning process. Social interaction is an important dimension of science learning and thus teaching and learning of the sciences can be comprehended and evaluated from the social constructivist perspective with a high degree of accordance.

Extensive studies on science education research draw attention to learning barriers that chemistry students confront in the classroom environment and necessitate informed instruction that is integrative of knowledge that encompasses perspectives of both learning theorists and science education researchers. Chemistry instructors who are able to recognize initial student misconceptions can purposefully design learning activities that incorporate contextualized technological and physical resources, demonstrations, and phased enactive, iconic, and symbolic learning scaffolds that meet their learners' needs. In order to systematically undertake this complex approach to teaching, instructors need to be able to build bridges between deep understanding of chemistry constructs (disciplinary expertise) and praxiological (theory into practice/process expertise) to support chemistry learners in overcoming misconceptions.

REFERENCES

Atwater, M. M. (1996). Social constructivism: Infusion into the multicultural science education research agenda. *Journal of Research in Science Teaching*, *33*(8), 821-837.

Bodner, G. M. (1986). Constructivism: A theory of knowledge. *Journal of Chemical Education*, *63*, 873−878.

Bruner, J. (1966). *Toward a theory of instruction*. Cambridge, MA: Harvard University Press.

Bucat, C. (2004). Pedagogical content knowledge as a way forward: Applied research in chemistry education. *Chemistry Education: Research and Practice*, *5*(3), 215-228.

Candy, P. C. (1991). *Self-direction for lifelong learning* (1st ed.). San Francisco, CA: Jossey-Bass.

Cooper, M. M., & Sandi-Urena, S. (2009). Design and validation of an instrument to assess metacognitive skillfulness in chemistry problem solving. *Journal of Chemical Education*, *86*(2), 240−245.

Fenwick, T. (2003). *Learning through experience: Troubling orthodoxies and intersecting questions*. Malabar, FL: Krieger Publishing.

Fox, R. (2001). Constructivism examined. *Oxford Review of Education*, *27*(1), 23-35.

Gabel, D. (1999). Improving teaching and learning through chemistry education research: A look to the future. *Journal of Chemical Education*, *76*(4), 548-554.

Johnstone, A. H. (1991).Why is science difficult to learn? Things are seldom what they seem. *Journal of Computer Assisted Learning*, *7*(2), 75-83.

Johnstone, A. H. (1997). Chemistry teaching-science or alchemy? 1996 Brasted Lecture. *Journal of Chemistry Education*, *74*(3), 262.

Lin, L. (2015). Constructivist theory. In J. M. Spector (Ed.). *Encyclopedia of educational technology* (pp. 144-146). Thousand Oaks, CA: Sage.

Mahaffy, P. (2004). The future shape of chemistry education. *Chemistry Education: Research and Practice, 5*(3), 229-245.

Matsumura, L. C., Slater, S. C., & Crosson, A. (2008). Classroom climate, rigorous instruction and curriculum, and students' interactions in urban middle schools. *The Elementary School Journal, 108*(4), 294-312.

Mezirow, J. (1990). *Transformative dimensions of adult learning*. San Francisco, CA: Jossey-Bass.

Novak, J.D. (2010). *Learning, creating, and using knowledge: Concept maps as facilitative tools in schools and corporations* (2nd ed.). New York, NY: Routledge, Taylor-Francis.

Nystrand, M. (1996). *Opening dialogue: Understanding the dynamics of language and learning in the English classroom*. New York, NY: Teachers College Press.

Ormrod, J. E. (1995). *Human learning* (2nd ed.). Englewood Cliffs, NJ: Merrill.

Osborne, J. F. (1996). Beyond constructivism. *Science Education, 80*(1), 53-82.

Parchoma, G. (2015). Distributed cognition in computer-supported collaborative learning. In J. M. Spector (Ed.). *Encyclopedia of educational technology* (pp. 233-237). Thousand Oaks, CA: Sage.

Pratt, D. D. (1998). *Five perspectives on teaching in adult and higher education*. Malabar, FL: Krieger Publishing Company.

Rickey, D., & Stacy, A. M. (2000). The role of metacognition in learning chemistry. *Journal of Chemical Education, 77*(7), 915−920.

Sheckley, B., & Bell, S. (2006). Experience, consciousness and learning: Implications for instruction. In S. Johnson, & K. Taylor (Eds.), *The neuroscience of adult learning: New directions for adult and continuing education, number 110* (pp. 43-52). San Francisco, CA: Jossey-Bass.

Shulman, L. (1986). Those who understand: Knowledge growth in teaching. *Educational Researcher, 15*(2), 4-14.

von Glasersfeld, E. (1984). An introduction to radical constructivism. In P. Watzlawick (Ed.), *The invented reality: How do we know what we believe we know?* (pp. 17-40). New York, NY: Norton.

Vygotsky, L. S. (1986). *Thought and language* (Rev. ed.). Cambridge, MA: MIT Press.

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Cambridge, MA: Harvard University Press.

Weerawardhana, A., Ferry, B., & Brown, C. (2006). Use of visualisation software to support understanding of chemical equilibrium: The importance of appropriate teaching strategies. *Proceedings of the 23rd annual ascilite conference: Who's learning? Whose technology? The University of Sydney*, 853-861.

Wieman, C. (2007). Why not try: A scientific approach to science education? *Change, 39*(5), 9-15.

Whitman, N. (1990). *Creative medical teaching*. Salt Lake City, UT: University of Utah School of Medicine.

ONE STEP BACK, THREE FORWARD: SUCCESS THROUGH MEDIATED CHALLENGE

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How can you keep all students engaged in deepening their mathematical understanding without overwhelming the weakest students or boring the strongest? Teachers in the Math Minds project design lessons around structured sequences that seek to engage all students with questions on which they can succeed, and to then proceed through increasingly sophisticated variations. Teachers attend closely to student responses so that they can adjust difficulty in a manner that allows success and challenge for all. In this paper, we describe key principles that have emerged from the Math Minds initiative. We draw particular attention to variation theory (Marton, 2015) and consider how it plays out in interaction with the other principles.

Keywords: Mathematics education; Mastery learning; Variation theory

WHAT IS MATH MINDS?

The ideas we report here are based on our work as researchers for the Math Minds project, a five-year partnership between the Werklund School of Esducation, JUMP Math, the Calgary Catholic School District, the Calgary Public Library, and the Boys' and Girls' Club of Calgary and sponsored by Canadian Oil Sands Limited. The project aims to enhance early numeracy, and our research is framed within the broad goal of understanding what teachers need to know to effectively teach elementary mathematics. Our research team is particularly interested in how

access to a particular resource (in this case, JUMP Math, 2015) and related professional development pertaining to effective use of that resource might support (a) the development of teachers' knowledge for teaching mathematics and (b) student achievement. We begin with a brief summary of core principles emerging as significant to our work, with a particular focus on how variation theory (Marton, 2015; Runesson, 2005; Watson & Mason, 2006) both supports and is informed by the other principles.

CORE PRINCIPLES

After one year of teachers' supported use of JUMP materials with all students in a K-6 school with a history of low mathematical performance, we observed a number of changes in how students engaged with mathematics. Based on weekly observations and student interviews, we noticed that students who previously struggled become more willing to take part, and many students became excited to keep pushing their understanding to new levels. At the same time, students' scores for mathematics on the Canadian Test of Basic Skills (Nelson, 2014) showed a significant increase in national percentile rankings from 2013 (M = 30.28, SD = 25.06) to 2014 (M=36.37, SD=23.88); t(66)=-2.97, p = 0.004.

Here, we elaborate the core principles that we believe are significant to the successes we have observed. While each is connected to a significant body of educational research in its own right, it appears that together they can inform mathematics education in ways that go beyond the sum of their parts. Our work is grounded in the assumption that all students can succeed at challenging mathematics. Blackwell, Trzesniewski, and Dweck (2007) emphasized the importance of a *growth mindset*: They showed that teaching students that mathematical ability is learnable (not innate) supports achievement in mathematics. Following JUMP Math, we take this one step further by structuring instruction in ways that *demonstrate* to students that they *are* successful—importantly,

without extensive remediation. JUMP's methods (JUMP Math 2015; Mighton, 2007) adhere to key principles of *mastery learning* (Guskey, 2010), which emphasizes the importance of pre-assessment to determine an appropriate entry level, group instruction, regular formative assessment, instruction that continually responds to assessment, and opportunities for extension. In our work, this has included a clear emphasis on starting at a point that every student can be included and engaged, stepping up in small increments while ensuring nobody gets left behind, and offering frequent extensions so that all remain sufficiently challenged and engaged. If students struggle, the teacher creates a smaller step rather than attempting to remediate (*cf.* Preciado-Babb, McInnis, Metz, Sabbaghan, & Davis, 2015; Sabbaghan, Metz, Preciado-Babb, & Davis, 2015). *Formative assessment* (Wiliam, 2011), then, is key: Student responses continually influence next steps in instruction—i.e., many times during a single lesson. All of this is consistent with the literature on *intrinsic motivation*, which emphasizes the importance of autonomy, mastery, and purpose (Pink, 2011). Data we have gathered from interviews with students from Grades 1 through 6 has shown that students at all levels like math best when they can succeed with little assistance from the teacher. Key aspects of purpose include appropriate challenge and connecting to others, both of which become evident in a classroom where all students confidently engage together in a lesson that climbs steadily to higher levels. By building a strong base of common understanding, students more easily form a *learning collective* in which they are further able to engage together in challenging work that draws on their diverse interests and abilities (Davis & Simmt, 2003) and provides a context in which *emergent mathematical understanding* (Davis & Renert, 2015) can flourish. By starting at a level that includes everybody and moving steadily forward together (with some extending further than others), it is possible for all students to move further than they might

otherwise have done. *Variation theory* provides a way of attending to mathematical structure that supports each of these principles.

JUMP Math (2015) is a carefully sequenced mathematics program that demonstrates aspects of effective mathematical variation. The resources were developed and are frequently refined in response to student engagement and understanding (Mighton, 2007). In our analysis of and work with these materials, we have explicitly invoked variation theory, while maintaining a clear emphasis on student engagement and understanding as key litmus tests of effectively sequenced instruction. Variation theory has proven particularly helpful in our attempts to support teachers in extending what is offered in the resources, both in terms of creating easier steps and creating extensions. This is important to students both psychologically in terms of creating high levels of success and challenge and mathematically in terms of portraying mathematics as connected and extendable.

In a nutshell, variation theory includes (a) clear focus on a particular "object of learning"; (b) identification of features that can vary within that object of learning ("dimensions of possible variation"); (c) the development of sequences of exercises that systematically vary these features, first one at a time (while holding others constant), then simultaneously; and (d) attention to contrasts and generalizations that can become apparent in this space of variation.

Consider how the items in Table 1 vary from one to the next (we encourage the reader to work through them). In addition to number facts, what might be learned here? In other words, what is the object of learning?

Addition Sequence	Subtraction Sequence
7+5=	7-5=
7+6=	7-6=
7+7=	7-7=
8+7=	8-7=

9+7=	9-7=
10+7=	10-7=
11+8=	11-8=
12+9=	12-9=
13+10=	13-10=
14+9=	14-9=
15+8=	15-8=
16+7=	16-7=

Table 1: Addition and subtraction sequences.

In each sequence, first one number, then the other, and then both increase by one, and then one goes up while the other goes down (and further note that the effect of this variation is not the same for the addition sequence as for the subtraction sequence). The point of such variation is to draw attention to relationships between changing addends (or minuends/subtrahends) and sums (or differences). Since stumbling at one step could create significant difficulty at the next, assessment of all students at each step is essential. It may be important to include more repetition within particular sections or to insert smaller steps. For example, it may be necessary to explore *decreasing* addends or subtrahends/minuends before attempting "one-up-one-down." The list can be extended as needed with more challenging items, for example by increasing or decreasing the numbers by amounts larger than one. Much larger numbers could be used to help draw attention to relationships rather than to isolated calculations. For example, given 73+55=128, what is 74+55? Consider a second example. Recently, Metz was working with a student to count money. After ensuring that he could skip-count by 5s, 10s, and 25s, she was tempted to ask him to find all the ways to make a particular amount of money with nickels, dimes and quarters. This could prompt him to think more flexibly about coin combinations, to work systematically, and to consider how he knew when he was finished. Instead, she asked him to "find a way to make 30 cents that uses 3 coins." Although this variation has a single correct answer, trying something and then adjusting

also provides a context where flexibly grouping coins becomes likely, and without adding the additional difficulty of considering "all combinations." Extending the question to "find a way to make 30 cents that uses *4* coins" is a small enough variation that it might prompt adjustment to the first problem to find a solution to the second; e.g., trade one dime for 2 nickels to get an extra coin. Note that this would be less likely if the next question were not closely connected to the first. Students might then be asked to find solutions with 5 coins or 6 coins…then perhaps 2, which would involve re-combining nickels into a quarter. They might try a similar progression for 35 cents. Having thus had some experience with *systematically* manipulating the coins, they might *then* be asked to find *all* the ways to make 40 cents. Anything from 50 to 74 cents adds the possibility of a second quarter and allows many more possibilities. In this way, the size of step can easily be tailored to the level of challenge that a particular child finds engaging, but everybody gets to experience success at the base level, everybody has the opportunity to master the object of learning for the lesson, and everybody can get a "bonus." Maybe somebody will find that finding all the ways to make $0.55 is an interesting challenge. However, starting there with the idea that everybody can at least find an entry point can sap motivation and overwhelm.

Now consider the previous examples in light of the questions in Table 2. In doing so, we hope the significance of the *set* becomes apparent. Here, variation theory is informed by other principles deemed significant to Math Minds. For example, Questions 4 and 5 attend to intrinsic motivation and mastery learning, and Questions 6 and 7 attend specifically to emergent knowing.

1. What is the object of learning?
2. What dimensions can vary? What should stay the same?
3. Once explored individually, are there dimensions that can co-vary?
4. What prior knowledge is assumed for the simplest variation?
5. Are variations sufficiently broken down that students can approach each step independently?
6. What more could be learned from the set than from a single example or

from a poorly structured set?
7. How could the set be extended?

Table 2: Variation in Math Minds.

Variation comes in many forms. At times, the same problem might be solved with various strategies. For this to prompt deeper understanding than what was already available to any one particular student, each strategy can first be explored with its own variations before juxtaposing *different* strategies. In this way, attention is freed to consider relationships between various strategies, rather than merely an accumulation of alternative (and sometimes inefficient) ways to do something. Variation may also occur in increasingly complex mathematical contexts as students achieve mastery of component pieces; here students' attention may shift to the parsing and sequencing of familiar pieces. Again, starting small and building up can help ensure that everyone is included without placing a ceiling on how far a sequence might be extended.

There are times when it is important for students to take part in identifying and varying potential dimensions of variation, particularly when the variables and their impact are readily discernible by students. A very simple example might be found in a vintage children's toy, the Etch-a-Sketch. Essentially, it is a screen with a magnetic "cursor" that traces a line and can be moved up/down by turning one knob clockwise or counter-clockwise or right/left by turning the other knob. When challenged to draw a simple spiral (for example), students can experiment with the dimensions of variation available in the knobs and judge their progress by the image that appears on the screen. It is also possible to make discerning, naming, and exploring potential dimensions of variation the object of learning (*cf.* Metz & Simmt, 2015). In each case, it is important to consider what might vary and how the proposed tasks will draw attention to this variation.

SUMMARY

Taken together, the Math Minds principles offer a way to attend to both deep mathematical structure and the development of mathematical fluency. When teacher and student attention remains focused on key ideas and their continuous extension (and combination), all may participate in mathematical exploration in ways that avoid some of the difficulties sometimes experienced as teachers attempt to transition away from transmission-based models of math instruction (see Swan, Peadman, Doorman, & Mooldjik, 2013). By attending closely to the mathematical variation available to be experienced in a particular context and by structuring that variation in a responsive manner that allows all to succeed and all to be challenged, learners have the opportunity to expand their mathematical understanding in a manner that supports both deeply interconnected and emergent understanding as well as mathematical fluency.

REFERENCES

Blackwell, L., Trzesniewski, K. & Dweck, C. (2007). Implicit theories of intelligence predict achievement across an adolescent transition: A longitudinal study and an intervention. *Child Development 78*(1), 246-263.

Davis, B. & Renert, M. (2015). *The math teachers know: Profound understanding of emergent mathematics*. New York, NY: Routledge.

Davis, B., & Simmt, E. (2003). Understanding learning systems: Mathematics education and complexity science. *Journal for Research in Mathematics Education 34(2)*, 137-167.

Guskey, T. (2010). Lessons of mastery learning. *Educational Leadership 68*(2), 52-57.

JUMP Math (2015). JUMP Math. Retrieved from https://jumpmath.org/jump/en

Marton, F. (2015). *Necessary conditions of learning*. New York, NY: Routledge.

Metz, M. & Simmt, E. (2015). Researching mathematical experience from the perspective of an empathic second-person observer. *ZDM Mathematics Education 47*(2), 197-209.

Mighton, J. (2007). *The end of ignorance: Multiplying our human potential*. Toronto, Canada: Alfred A. Knopf.

Nelson (2014). *Assessment*. Retrieved from http://www.assess.nelson.com/default.html

Pink, D. (2011). *Drive: The surprising truth about what motivates us*. New York, NY: Riverhead.

Preciado-Babb, McInnis, Metz, Sabbaghan & Davis (2015). Epiphanies in mathematics teaching: The personal learning of an elementary teacher in the Math Minds initiative. In A. P. Preciado-Babb, M. Takeuchi & J. Lock (Eds.) *Proceedings of the IDEAS: Rising to Challenge Conference*. Calgary, Alberta: Werklund School of the Education, University of Calgary.

Runesson, U. (2005). Beyond discourse and interaction. Variation: A critical aspect for teaching and learning mathematics. *Cambridge Journal of Education 35*(1), 69-87

Sabbaghan, Metz, Preciado-Babb & Davis (2015). Dynamic responsive pedagogy: Implications of micro-level scaffolding. In A. P. Preciado-Babb, M. Takeuchi & J. Lock (Eds.) *Proceedings of the IDEAS: Designing Responsive Pedagogy*. Calgary, Alberta: Werklund School of the Education, University of Calgary.

Swan, M., Pead, D., Doorman, M, & Mooldjik, A. (2013). Designing and using professional development resources for inquiry-based larning. *ZDM Mathematics Education 45*, 945-957.

Watson, A. & Mason, J. (2006). Seeing an exercise as a single mathematical object: Using variation to structure sense-making. *Mathematical Thinking and Learning 8*(2), 91-111.

Wiliam, D. (2011). *Embedded formative assessment*. Bloomington, IN: Solution Tree.

EPIPHANIES IN MATHEMATICS TEACHING: THE PERSONAL LEARNING OF AN ELEMENTARY TEACHER IN THE MATH MINDS INITIATIVE

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The Math Minds partnership strives to increase student engagement, self-esteem and achievement in mathematics and also to deepen teachers' conceptual understanding of mathematics for instruction. Through this partnership, elementary teachers are changing the way they teach mathematics. By breaking concepts into small steps, continually assessing all children for understanding along the way and giving opportunities for independent "practice" frequently during each lesson, students have shown a significant improvement in mathematics. We present the transformative learning experience of one teacher during one year in this partnership, with surprising results.

Keywords: Mathematics teacher knowledge; Teacher practice; Elementary mathematics

INTRODUCTION

Several educators have contested the belief that some people can learn mathematics while others cannot (e.g. Davis & Preciado Babb, 2015; Dweck, 2008; Mighton, 2003, 2007). Even students

with learning disabilities, including mathematics disorders, can reach levels of achievement typical of the general population (Gouvier & Baumeister, 2011; Wei, Lenz, & Blackorby, 2013). Consistently, Carol Dweck's (2008) extensive research on intelligence and ability has shown that intelligence and ability can be nurtured and improved. Due to space limit, we do not elaborate on this research. Our point is that this evidence compels us to constantly strive for improvement in mathematics learning in schools. The Math Minds initiative—a partnership including the Calgary Catholic School District (CCSD), the Werklund School of Education (WSE) of the University of Calgary, and the JUMP Math organization—was created in an attempt to improve mathematics instruction at the elementary level, so every student learns and enjoys mathematics. Results from the early stages of this initiative have already shown significant, positive impact on students' performance in mathematics, as well as teachers' improvement of their knowledge to teach mathematics. In this paper, we describe the dramatic changes on teaching practices of one of the authors, McInnis, during the early stages of the initiative.

MATH MINDS

The overarching goals of the Math Minds initiative were to: (a) increase student engagement, self-esteem and achievement in mathematics; (b) deepen teacher's conceptual understanding of mathematics and application of mathematical knowledge to enhance classroom instruction; and (c) showcase excellence in teaching and learning mathematical concepts to the wider community. A team from the WSE has contributed to the partnership by undertaking research in the initiative as well as informing the ongoing teacher professional development. The CCSD provided a research school, as well as other schools involved in the project, and participated in the design of the sessions for professional development. The JUMP Math (2015) organization provided the

curricular material for teachers and contributed to teachers' professional development. Each partner has contributed to, and learned from, the overall project.

The instructional approach and the materials for teaching mathematics—the JUMP Math (2015) program—stresses the importance of continuous assessment during class to spot mistakes and misunderstandings right away, making sure that everyone can engage in the mathematical tasks and students build self-confidence as mathematics learners. This type of assessment has to be efficient and effective, so the teacher can make decisions in the moment, during class. Two main components of the approach in the initiative are: the breaking down of learning into fine-grained steps, consistent with the literature on variation theory (Marton, 2015); and the building of student self confidence, supported by the extensive research on mathematics anxiety and mathematics learning (e.g. Wu, Barth, Amin, Malcarne, & Menon, 2012).

By the second year of the initiative, all the teachers in the research school had adopted the JUMP Math materials and received continuous professional support. Additionally, one researcher visited each teacher's classroom at least every week, to observe and sometimes video-tape lessons. The researchers very often engaged in conversations with teachers, providing learning opportunities for both teachers and researchers.

Preliminary results

While we observed a general improvement of student performance in mathematics at the school during this year, McInnis's Grade Six students showed an impressive shift. The Canadian Test for Basic Skills (CTBS; Nelson, 2015) was administered at the beginning and at the end of the school year. The average score of the Grade Six class moved from 34th on the National Percentile Rank (NPR) to the 54th percentile. The results for students with initial performance below the average of

the group were even more surprising; the mean for this group of students went from the 10th NPR to the 41st NPR. Students with initial score above average also improved their performance. The mean for this group changed from the 68th NPR to 73rd NPR. We also noticed that students improved their attitudes toward mathematics as reflected in their participation and engagement during class, as well as the enjoyment reported by interviewed students.

The Grade Six teacher

McInnis had been a teacher for 14 years before participating in the Math Minds initiative. Based on the results of her students, she was invited to be a CCSD Consultant for the partnership during the third year of the initiative. In this position, she participated in the design and delivery of professional development for teachers, as well as supporting teachers in many other CCSD schools that started using the material. Such involvement contrasts with McInnis's initial reluctance to adopt the material and participate in the initiative. We elaborate on these changes, as well as the change process she experienced in the following sections.

CHANGE IN TEACHING PRACTICE

The changes of teaching practices that McInnis experienced during the initiative are strongly related to the emphasis on continuous assessment and breaking down content and instructions into small steps. Before the Math Minds initiative she used to spend a large part of the class introducing new content, and then assigning work and assisting students individually and in small groups. After being involved in the initiative, McInnis paced her lessons in a very different way. Instructions and information were given in small steps during the class, accompanied by instant assessment that informed the next steps in class. We summarize the changes in four overlapping categories described as follows.

Breaking down instruction and practice into small steps

Like many elementary mathematics teachers, McInnis often taught an entire new concept before assigning practice work—e.g. she provided many instructions and explanations and then students were expected to complete multiple tasks on one or two pages of practice. During the Math Minds initiative, she changed this practice by breaking down new concepts into very small steps—examples of this can be found in Metz, Sabbaghan, Preciado-Babb & Davis (2015) and Sabbaghan, Metz, Preciado-Babb & Davis (2015). Only one instruction or idea was introduced at time. As new content was broken down into small steps in the resource (JUMP Math, 2015), she assessed students' understanding and assigned practice only when she was sure that students were ready to successfully engage in the corresponding tasks. In contrast to her previous approach, practice consisted of a few items related to one single idea introduced at a time.

Assessing continuously

Previous to Math Minds, McInnis spent a lot of time assisting students individually, then running out of class time and not getting to assist everyone. This changed when she started assessing students continuously during class. She almost entirely eliminated the common practice of calling on students who raised their hands to give answers because, she realized, that only gives the opportunity to assess one student. Instead, during instruction, students constantly answered questions on individual whiteboards, which they held up for the teacher to see. This allowed her to ensure that every student understood the concepts during instruction. With small examples of practice throughout the lesson, most students were ready to do the mathematical task correctly and independently. There were, after implementing this small step during teaching and assessing, only one or two students who required individual assistance during practice work.

Assessing for previous skills and knowledge

Assessing students' previous skills and knowledge prior to presenting new content is also a component of assessment. The whiteboards were very useful for this purpose. After asking some questions at the beginning, McInnis was able to decide if students were ready to move on, or if some previous activities or scaffolding measures were required. While she was aware of the need to diagnose students before her involvement in Math Minds, such assessment became more systematic and effective during the initiative.

Assessing and assisting students in class

Typically, when introducing all the instructions and explanations at the beginning of a class, many students did not finish their practice and subsequently took it home to complete. McInnis was not able to assess and assist these students. In contrast, when parsing the content of the class into smaller steps, she was able to assess and assist students right there during class time. Throughout her first year in the initiative, her students never had mathematics homework.

Bonusing

An important component of the Math Minds Initiative is the use of bonus questions and tasks for students who finish their work early. Before being part of Math Minds, only a few of McInnis's students finished their work during class. Preparing something for early finishers was not required. As a result of participating in the initiative, she began challenging students with bonus questions and tasks. These never consisted of busy work or of letting students work on without instruction. Bonus work always challenged students deeper, but within the same concept that everyone was working on. It is worth noting that students became comfortable when being challenged with bonus

questions; moreover, many of them often requested bonus questions to the teacher, or even created their own bonuses for themselves.

THE CHANGE PROCESS

McInnis identified a turning point of change in teaching practices in a particular session of professional development during the Fall of 2013. The session focused on pacing and parsing the content and practice during class. Teachers watched videos of themselves teaching and marked the time spent for instructions, assessment and practice—a teacher's activity sheet is included in the appendix. Before watching the video of her lesson, McInnis was sure she was doing what was suggested for instruction in the session: splitting the lesson into small steps and assessing all students before providing practice. However, after watching the video she was shocked to notice that she actually did the opposite—i.e. she talked for more than twenty minutes before students had an opportunity to do some work. After this realisation, she was very eager to switch her teaching practices. This change was also evident in the data for this study, which included weekly video-recordings and an interview at the end of the year.

Another turning point identified by McInnis was the introduction of the whiteboards for continuous assessment, suggested by the WSE team. She recognized, pretty quickly, the advantage of assessing all students constantly instead of asking questions such as "Can anybody tell me …?" which lead to an assessment dead-end once one student gives the correct answer.

Soon after changing the way she was teaching, McInnis felt that her lessons had developed a rhythm. It became effortless for her to have the students engaged in the tasks during class. JUMP Math material supported this approach in the way it breaks down the content in both the students' practice and assessment books and the teachers' guide. However, McInnis found that the teacher

must be aware of these steps in order to better parse the content of a lesson. This includes how the teacher responds when not all students provide the expected answers during instant assessment.

Another important factor contributing to McInnis's change was the interaction with Steven, a postdoctoral fellow hired as researcher for this study. He visited McInnis's classroom for the whole year, assisting students during practice time and engaging in after-class discussions with her. McInnis observed him posing questions to some students as bonuses of mathematical extensions of the content of each step of the class. Soon, she found it easy to come up with these extensions herself.

CONCLUSION

Initially, McInnis was very reluctant to incorporate the JUMP Math material. However, after working closely with the research team and using the resource for some months, she experienced a dramatic shift in teaching practices. This was evident in the pacing and parsing of instruction and practice, as well as in her use of continuous assessment. Both students' measured performance in mathematics and McInnis's observations of her students represent strong evidence of the benefits of such changes. It is important to note that such change did not happen only due to the JUMP Math material. The professional development sessions and her ongoing conversations and interactions with Steven played a major role in effecting such change.

The belief that all students can do mathematics compels us to continually strive to improve mathematics teaching. Early results from the Math Minds initiative suggest that a combination of curricular material and professional support can result in a rapid change of mathematics teaching practices with a positive impact on students' learning. The turning points indicated in this paper

have already been factors considered for future planning within the initiative. We will continue to further explore factors that impact on teachers' practices and students' mathematical learning.

Acknowledgement

REFERENCES

Davis, B. & Preciado Babb A. P. (2015). Elementary Mathematics instruction and student diversity. In J. J. W. Andrews and J. L. Lupart (Eds.), *Diversity Education: Understanding and Addressing Diversity* (pp. 393 – 322). Toronto, Canada: Nelson Education Limited.

Gouvier, W. & Baumeister, A. (2011). Mathematics disorders. In *The encyclopedia of neuropsychological disorders*. New York: Springer Publishing Company.

Dweck, C. S. (2008). *Mindset: the new psychology of success*. New York, NY: Ballantine Books.

JUMP Math (2015). JUMP Math. Retrieved from https://jumpmath.org/jump/en

Marton, F. (2015). *Necessary conditions of learning*. New York: Routledge.

Mighton, J. (2003). *The myth of ability: Nurturing mathematical talent in every child*. Toronto, Canada: Anansi.

Mighton, J. (2007). *The end of ignorance: Multiplying our human potential*. Toronto, Canada: Alfred A. Knopf.

Metz, M., Sabbaghan, S., Preciado-Babb, A. P., & Davis, B. (2015). One Step Back, Three Forward: Success Through Mediated Challenge. In A. P. Preciado-Babb, M. Takeuchi & J.

Lock (Eds.) *Proceedings of the IDEAS: Design responsive pedagogy*. Calgary, Alberta: Werklund School of the Education, University of Calgary.

Nelson (2015). CTBS Form K Levels 9-14 (1998). Retrieved from http://www.assess.nelson.com/group/ctbs-k94.html

Sabbaghan, S., Metz, M., Preciado-Babb, A. P., & Davis, B. (2015). Dynamic Responsive pedagogy: Implications of Micro-level scaffolding. In A. P. Preciado-Babb, M. Takeuchi & J. Lock (Eds.) *Proceedings of the IDEAS: Design responsive pedagogy*. Calgary, Alberta: Werklund School of the Education, University of Calgary.

Wei, X., Lenz, K. B., & Blackorby, J. (2013). Math growth trajectories of students with disabilities: Disability category, gender, racial, and socioeconomic status differences from ages 7 to 17. *Remedial and Special Education*, *34*(3), 154–165.

Wu, S. S., Barth, M., Amin, H., Malcarne, V., & Menon, V. (2012). Math anxiety in second and third graders and its relation to mathematics achievement. *Frontiers in Psychology*, *3*(June), 1–11. doi:10.3389/fpsyg.2012.00162

APPENDIX: TEACHER ACTIVITY SHEET FOR ANALYSING LESSON

VIDEO-RECORDING

Lesson Self-Observation

Each section in the image below represents 1 minute. As you are watching your lesson, note at what points significant events and shifts take place.

Color-code the bars to show which minutes are primarily instruction (yellow), assessment (blue), and practice (green). Some sections may be left blank for transitions, announcements, etc. Note instances of bonusing with an *.

Of course, students may be working in their AP books as the teacher is circulating and assessing. We hope the following definitions will allow some consistency:
- *Instruction*: **Teacher is addressing the whole class.**
- *Assessment*: **The teacher is gathering evidence of understanding from the entire class.**
- *Practice*: **Students are practicing independently or with another student(s) (e.g. in a game or activity).**

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |

Consider the transitions between colors on your bar:
- What prompted shifts between various sections? (e.g. getting through content, kids getting antsy, everyone ready, etc.)
- Would smaller chunks have been helpful? (e.g. smaller steps during instruction, less instruction before practice, etc.)

Designed by Martina Metz and Soroush Sabbaghan

DYNAMIC RESPONSIVE PEDAGOGY: IMPLICATIONS OF MICRO-LEVEL SCAFFOLDING

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In mathematics education, scaffolding is often viewed as a mechanism to provide temporary aid to learners to enhance mathematical understanding. Micro-level scaffolding is process by which the teacher returns the student(s) to a conceptual point where scaffolding is not needed. Then the teacher creates a series of incrementally more complex tasks leading to the original task. This process is dynamic, as it often requires multiple steps, and it is responsive because involves moment-by-moment assessment, which shapes each increment. In this paper, we present data on how experienced teachers in the Math Minds Initiative employ micro-level scaffolding. Implications of micro-level scaffolding are discussed.

Keywords: Scaffolding; Responsive pedagogy; Mathematics education; Mathematics for teachers

INTRODUCTION

In this paper, we report on a shift in how elementary school teachers implement scaffolding to enhance mathematics learning. The data we gathered as researchers in the Math Minds initiative include video recordings and observations of classrooms that used JUMP Math as their primary resource. The Math Minds initiative is a five-year partnership that includes the University of Calgary, JUMP Math, and the Calgary Catholic School District. The project aims to enhance early

numeracy, and our research is framed within the broad goal of understanding what teachers need to know to effectively teach elementary mathematics.

Our data was collected at a small urban K-6 elementary school in Alberta. The national percentile ranks (NPR) on the Canadian Test of Basic Skills (Nelson, 2014) was used to track students' mathematical competencies after one year of participating in the Math Minds initiative, which used JUMP Math as its primary resource, and included professional development informed by ongoing research. The results indicated that there was a significant increase in NPRs. Therefore, it would seem that teachers have had some success in implementing Math Minds principles and in using the resource effectively.

Drawing from the data we have gathered over the course of two years, we witnessed the evolution of teachers' implementation of scaffolding strategies in the Math Minds Initiative. In this paper, we present two types of sample data. First, we describe scaffolding strategies implemented by two teachers teaching the same lesson, one during their first and one during their second year of participating in the initiative. Second, we report on teachers' (some using JUMP Math for about 3 months, and some using JUMP Math for more than a year) scaffolding strategies in response to a semi-fictional scenario in a professional development session. Finally, we offer some insights on why micro-level scaffolding strategies are more educative than mainstream strategies.

SCAFFOLDING IN MATHEMATICS EDUCATION

Scaffolding in mathematics education is a structure that has three key components (van Oers, 2014). First, it is generally considered to be an interactional process between a competent user of mathematics (teacher or peer) and a student or a group of students. Second, the aim of this process is to provide appropriate and temporary aid to enhance mathematical understanding, which may

include the learning of mathematical actions and problem solving strategies. Third, scaffolding is essentially a temporary measure of assistance, and it is supposed to fade away as the learner becomes more competent.

The idea of supporting a learner through interaction until the learner is able to complete a task without support is unequivocally connected to the Vygotskian notion of zone of proximal development (Vygotsky, 1978). Building on this framework, Stone (1993) has suggested that successful scaffolding does more than allowing the learner to achieve a specific goal in the immediate context. In other words, Stone asserts that scaffolding is successful when the learner understands the value of the scaffolding action for future activities. To evaluate the effectiveness of such scaffolding, it is logical to provide students with opportunities to implement the knowledge acquired through scaffolding.

Employing scaffolding strategies in mathematics education can be quite a daunting task for the mathematics teacher. To aid teachers, some scholars have introduced different educative strategies for implementing scaffolding with different levels of explicitness (see van de Pol 2012). One the most popular scaffolding strategies is *modelling*, which is basically showing aspects of task performance. *Giving advice* or providing learners with suggestions with the aim of helping them improve their performance is another strategy. *Coaching* or giving tailored instructions for corrective performance is another common scaffolding strategy. Although these strategies are important in mathematics education, with each serving a different purpose, they are designed to provide remediation rather than take the students to the edge of their mathematical competence.

SCAFFOLDING IN THE MATH MINDS INITIATIVE

First year

The video recording data we gathered early in the project seems to indicate that teachers often employed traditional scaffolding strategies such as modelling, coaching, and giving advice. In one classroom video recording, we observed the teacher asking students to identify two-digit numbers on a 100s chart. The procedure was simple. The teacher spoke a number between one and 100, and the students found the number on their 100s chart. The teacher then randomly asked a student to come to the Smart Board and highlight the number that was read. In one occasion, the teacher asked the students to find "43" on their 100s chart. Then the teacher asked a student to come to the Smart Board to "find" the number 43, but the student highlighted the number "34," as shown in Figure 1.

Figure 1: Identifying numbers before and after corrective measures.

A transcript of the conversation that followed is shown below:

Teacher: Look at what [name] did. [name] listen to the number. Forty-three. What number does that end with?

Student: Three

> Teacher: Three. Does that end in a three? You have the correct number… the digits are correct, but where is forty-three? Come back and see if you could change your guess… so do we look at the 3 column or the 4 column to find forty-three? Where would be go for 43?

> Student: here [correctly marks 43].

An analysis of the transcript reveals that the teacher used a coaching strategy by directing the learner's attention to the ones place value (3 or 4) in forty-three, then informing the students that the digits were correct, and finally refocusing the student's attention to the ones place value by asking which column to look for "43." In the lesson, once "43" was marked by the student, the teacher moved on to "63" and asked another student to identify it on the Smart Board.

Second year

In the second year of the project, a similar incident occurred in the same lesson described above. The teacher read numbers (from 1 to 100), and the students were asked to put a block on the number they heard on the 100s chart. The teacher went around the room and monitored students' performance. In one sequence the teacher asked students to identify "47." However, some of her students placed their blocks on the number "74," as depicted in Figure 2.
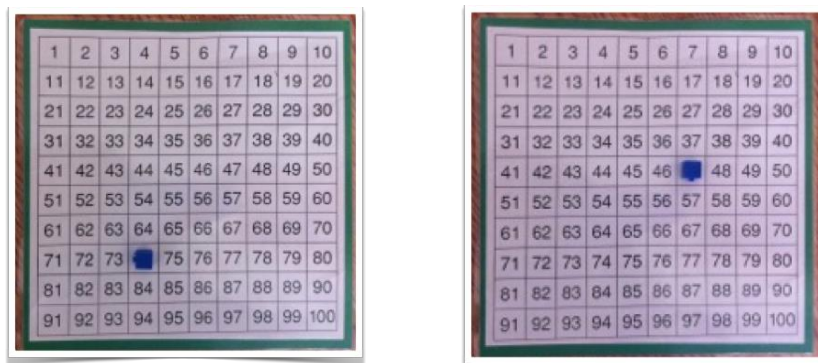

Figure 2: Student's misinterpretation of 47.

The teacher, who had participated in a series of professional development sessions focusing on mastery learning (Guskey, 2010) and formative assessment (Wiliam, 2011) as part of the Math Minds initiative, employed a micro-level scaffolding strategy. An important principle in micro-level scaffolding is starting with something known. In other words, micro-level scaffolding is not only a corrective measure per se: It is stepping back and building up in a manner that would allow the learners to complete the original task correctly and independently. In this instance, the teacher asked the students to identify the number "40" on their 100s charts. The reason this number was selected was because it is not possible to confuse the ones digit and the tens digit, as the number "04" does not exist on the 100s chart. We observed that everyone in the class correctly identified the number 40. Next, she asked her students to identify the number "41," and then she monitored the class to make sure that everyone had correctly identified this number. She then asked her students to identify the following numbers in sequence, each time monitoring to make sure that everyone had identified the correct number: 42, 43, 44, 45, 46, 47. Her decision to create a task with this particular sequence was likely informed by *variation theory* (Marton, 2015; Runesson, 2005; Watson & Mason, 2006), which includes the notion that the development of sequences in a task should systematically vary in a manner that would allow only one aspect to change while other aspects remain constant. In this particular sequence, the ones digits vary but the tens digits remain invariant. Structuring the task in this manner allowed the teacher to focus the students' attention on the ones place value, which was meant to rectify any confusion existing between the ones and tens place values. Next, the teacher asked the students to identify the number "67." This time, everyone in the class correctly identified the number on their 100s chart. This allowed the teacher to assess whether the confusion regarding place values had been alleviated. This objective would not have been met had the teacher asked her students to identify the number "55" or "90."

PERCEPTIONS OF SCAFFOLDING

As part of a professional development session, Figure 2 was presented to a group of elementary school teachers, who had various degrees of experience using JUMP Math (some a few months, others more than a year) as their primary resource. They were asked to provide an opinion on a scenario in which a second-grade teacher asked her students to identify the number "47," and the majority of the students put a block on the number "74." Table 1 summarizes and categorizes the teachers' suggestions based on their experiences.

Less than one year in Math Minds		More than one year in Math Minds	
Suggestion	Category	Suggestion	Category
Review skip-counting – ask them to change their answer	Modelling	Ask to find 10, 20, 30, 40, 41, 42, 43, …46	Micro-level Scaffolding
Ask them to make 47 with tens and ones blocks	Couching	Ask to find 10, 11, 15, 16, 26, 36, 46	Micro-level Scaffolding
Ask what comes after 46	Couching	Ask to find 1, 10, 20, 30, 40, 41, 42, …, 46	Micro-level Scaffolding
Give hint on which row and column has the answer	Giving advice	Ask to find 40, if they can, ask to find 45, if they can, ask them to find 46, and 47	Micro-level Scaffolding
Review 100s chart	Modelling		

Table 1: Teachers' scaffolding strategies.

The classification of suggestions by teacher presented in Table 1 is an indication of a fundamental difference between teachers, who where participants in the Math Minds initiative for more than one

year, compared to those who were their first year, in how they view appropriate responsive pedagogical actions. While teacher who were participants in the project for less than one year seem to be inclined to use more traditional scaffolding strategies such as modelling and coaching, teacher in the project for more than one year view employing micro-level scaffolding strategies as responding appropriately. The more experienced Math Minds teachers also mentioned that after everyone in the class was able to identify the number "47" on their 100 chart, they would ask their students to identify a similar number such as 57 or 87 to make sure that the students were skilful enough to complete a similar task correctly and independently. Furthermore, one of the more experienced teachers also mentioned that she would extend this exercise by asking her students to identify the number which was "one more than 57" in order to create a challenge and keep her students engaged.

Implications of dynamic micro-scaffolding

Micro-level scaffolding seems to be deeply embedded in responsive pedagogy. One aspect in which it differs from mainstream scaffolding strategies is in the frequency of its occurrence. This type of scaffolding is meant to occur on a moment-by-moment basis. A JUMP Math lesson is structured in a manner that allows material to be presented in small increments (Mighton, 2007). After each increment, the teacher assesses whether the students can apply the knowledge independently and correctly. If for whatever reason the increment suggested by the resource is too big of a conceptual jump for a particular group of students, the teacher employs micro-level scaffolding.

Micro-level scaffolding is informed by a series of principles and actions. If students struggle to correctly implement the knowledge that they have received, the teacher *steps back* and returns the

students to a point where the teacher is sure that all students can apply their knowledge correctly and independently. For example, in the scenario presented above, when students could not identify the number "47" on their 100s chart, the more experienced Math Minds teachers asked their students to identify either the number "1", "10", or "40" depending on what they perceived their students would be able to do. The teacher would then guide the students by *stepping up* in small increments, each time monitoring to make sure that all students responded correctly to the micro-task, until everyone in the classroom was able to correctly complete the original task (e.g. identifying the 47 on their 100s chart). Before moving onto the next increment, the teacher needs to make sure that the students are able to correctly and independently apply this new skill. To do so, the teacher should ask the students to do a task similar to the one they had just completed, without providing scaffolding. When all students are successful in their application, the teacher could either move on to the next increment, or create a more challenging task (but she has be reasonably sure that his/her students are able to complete this task) to keep students engaged.

Employing micro-level scaffolding ensures that no student gets left behind and that students are constantly and sufficiently engaged. Furthermore, the lesson structure when using this kind of scaffolding includes a series of cycles, which contain elements of new content, assessment, stepping-up/stepping-back, and practice. In this type of lesson structure, students' responses inform what the teacher needs to do next, which is in essence a form of responsive pedagogy.

Acknowledgement

REFERENCES

Guskey, T. (2010). Lessons of mastery learning. *Educational Leadership 68*(2), 52-57.

JUMP Math (2015). JUMP Math. Retrieved from https://jumpmath.org/jump/en

Marton, F. (2015). *Necessary conditions of learning*. New York: Routledge.

Mighton, J. (2007). *The end of ignorance: Multiplying our human potential*. Toronto: Alfred A. Knopf.

Nelson (2014). Assessment. Retrieved from http://www.assess.nelson.com/default.html

Runesson, U. (2005). Beyond discourse and interaction. Variation: A critical aspect for teaching and learning mathematics. *Cambridge Journal of Education 35*(1), 69-87

Stone, CA. (1993). What is missing in the metaphor of scaffolding? In E.A. Forman, M. Minick, & C.A. Stone (Eds.), *Contexts for learning: Sociocultural dynamics in children's development* (pp. 169–183). New York: Oxford University Press.

Wiliam, D. (2011). *Embedded formative assessment*. Bloomington, IN: Solution Tree.

Watson, A. & Mason, J. (2006). Seeing an exercise as a single mathematical object: Using variation to structure sense-making. *Mathematical Thinking and Learning 8*(2), 91-111.

van de Pol, j. (2012). *Scaffolding in teacher-student interaction. Exploring, measuring, promoting and evaluating scaffolding*. Unpublished doctoral dissertation, University of Amsterdam: The Netherlands.

van Oers, B. (2014). Scaffolding in Mathematics Education. In S. Lerman (Ed.), *Encyclopaedia of Mathematics ducation* (pp. 535-538): Springer: The Netherlands.

Vygotsky, L. S. (1978). *Mind in society*. Cambridge MA: Harvard University Press