UNIVERSITY OF CALGARY

THE INVENTION OF GOOD GAMES:

UNDERSTANDING LEARNING DESIGN IN COMMERCIAL VIDEO GAMES

by

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A THESIS

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Abstract

This work sought to help inform the design of educational digital games by the studying the design of successful commercial videogames. The main thesis question was: *How does a commercially and critically successful modern video game support the learning that players must accomplish in order to succeed in the game (i.e. get to the end or win)?* This work takes a two-pronged approach to supporting the main argument, which is that the reason we can learn about designing educational games by studying commercial games is that people already learn from games and the best ones are already quite effective at teaching players what they need to learn in order to succeed in the game. The first part of the research establishes a foundation for the argument, namely that accepted pedagogy can be found in existing commercial games. The second part of the work proposes new methods for analysing games that can uncover mechanisms used to support learning in games which can be emplyed even if those games were not originally designed as educational objects. In order to support the claim that 'good' commercial videogames already embody elements of sound pedagogy an explicit connection is made between game design and formally accepted theory and models in teaching and learning. During this phase of the work a significant concern was raised regarding the classification of games as 'good', so a new methodology using Borda Counts was devised and tested that combines various disjoint subjective reviews and rankings from disparate sources in non-trivial manner that accounts for relative standings. Complementary to that was a meta-analysis of the criteria used to select games chosen as subjects of study as reported by researchers. Then, several games were chosen using this new ranking method and analysed using another new methodology that was designed for this work, called

Instructional Ethology. This is a new methodology for game design deconstruction and analysis that would allows the extraction of information about mechanisms used to support learning. This methodology combines behavioural and structural analysis to examine how commercial games support learning by examining the game itself from the perspective of what the game does. Further, this methodology can be applied to the analysis of any software system and offers a new approach to studying any interactive software. The results of the present study offered new insights into how several highly successful commercial games support players while they learn what they must learn in order to succeed in those games. A new design model was proposed, known as the 'Magic Bullet' that allows designers to visualize the relative proportions of potential learning in a game to assess the potential of a design.

Preface

This thesis represents a confluence of my three main vocations: the ethology, computer science, and education. It is also theoretical Thesis, which according to MLA Handbook for Writers of Research Papers defends an interesting, important, and novel claim, i.e., a thesis (or set of related claims/theses) that the writer sets forth at the beginning of the Thesis and which argues for its validity in the body of the Thesis by means of supporting evidence, analysis and arguments.

In one way or another I've been an ethologist as long as I can remember - spending countless hours as a child sitting ad watching the animals around me.

When I began to study CS formally I would ever have dreamed that I would eventually re-introduce what I had learned (and continue to learn) about behaviour to the problem of software behaviour and specifically game behaviour.

There are 2 chapters for the lit review because I need to pull together ideas from many different areas: culture; learning; design

Notes on Format and Resources

The Use of Pronouns

There has been no attempt to balance the use of male and female pronouns in this work. As it was the author recording most of the in-game behaviours, the feminine pronoun is used most often.

Games Cited in the Text

Digital games cited in the text are referenced in a section separate from other the bibliography. There is as yet no formally recognized citation style for digital games, and since many digital games do not credit individual creators, they are listed by title rather than auteur. Where possible, links to the official game site is also provided.

The Use of Screenshots

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Screenshots credited to K.Becker

At the time of this writing (July-Dec. 2007), copyright issues with respect to the use of screenshots taken from a personally owned computer or game console using a camera or some form of screen capture software have not been resolved. Many game companies and publishers routinely ignore requests for permission to use images in scholarly publications which could, in the spirit of 'Fair Use' be taken as tacit approval.

Screenshots of Black & White

Permission to use screenshots of the game *Black & White* from the website of Lionhead Studios (http://www.lionhead.com/) was sought on Dec 29, 2007 and received on Jan. 4 2008 via email. All uses are credited with the image. In some cases, the image has been cropped.

A Note on the Links within the PDF Version of this Document

This document was originally produced online and active links to internet sites have been preserved in the PDF version. Note that many links to other locations within the thesis connect to the online version, rather than the PDF document – particularly the citations. Every attempt was made to convert chapter, figure and table references so they link to locations within the document. My apologies for any I have missed.

Acknowledgements

I would like to thank my supervisor, Dr. Michele Jacobsen for sticking with me through thick and thin and always offering encouragement when I needed it most. I would also like to thank my supervisory committee, Dr. Gail Kopp and Dr. John Mueller who provided alternate points of view and the occasional hard question. I am grateful to Dr. Richard Levy, who was kind enough to serve as an internal-external on both my candidacy and final oral. Not only has he proven he has 'game' but he has regularly surprised me with his depth of knowledge and insight. I also thank Dr. Carrie Heeter who agreed to be my external examiner without even having seen the size of this volume. I thank you all for reading and considering my work. Special mention also goes to Dr. Suzanne de Castelle who managed, in the brief time she acted as a co-supervisor, to help me focus my arguments and clarify my langiage.

I offer a special thanks to my mom, Renate Bischof, who planted the notion in my head early on that I could accomplish anything I set my mind to do. Without that, I'm not sure I could have persevered. To my children, Adam, Bailey, and Max – thank you for your patience, for the space you gave me to think and to rant, and for the casual way you all simply asumed I would succeed. To my various and sundre critters – dogs, cats, and all the rest: thank you for making me laugh and for keeping me in touch with what real life is about – I knew that no matter what happened, I could always could always count on you to treat me with no more or less respect than I had earned.

Finally, to Jim, my husband who is responsible for starting me on this journey. Your confidence in me never wavered, even when mine did. I could not have done this without yor help. There are no words big enough to express what your support has meant to me.

Dedication

For Klaus Becker, my Dad.

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List of Symbols, Abbreviations, Nomenclature

Abbreviations

ACWW	*Animal Crossing, Wild World* Nintendo DS game
AIAS	Academy of Interactive Arts and Sciences
DiGRA	Digital Games Research Association
DS	'Double Screen' (Nintendo Handheld Console)
FPS	First Person Shooter
HCI	Human-Computer Interface
ID	Instructional Design
IGN	Independent Game Network)
LARP	Live Action Role Playing Game
MMO	Massively Multiplayer Online Game
NPC	Non-Playing (or Non-Playable) Character
RPG	Role Playing Game
SENG	Software Engineering
SL	Second Life

Nomenclature

This glossary defines how various terms are used in this work. Although their use here does not deviate dramatically from commonly accepted meanings, I have encountered sufficient opposition and argument over these words to warrant defining them for my purposes. Further, there are frequent discussions and debates about terminology among various game scholar communities that a clarification of how terms are used in this volume is reasonable while at the same time acknowledging that the 'debates' are far from definitive (Becker, 2007j). This may be especially true in a discipline as young as Game Studies.

**Figure 0.1 Consensus, conflict, correspondence
and conflict among experts.**

Consensus, conflict, correspondence and contrast among experts.

Shaw, M. L. G., & Gaines, B. (1989). Comparing Conceptual Structures: Consensus, Conflict, Correspondence and Contrast., from http://ksi.cpsc.ucalgary.ca/articles/KBS/COCO/

Image source: (Shaw & Gaines, 1989)

There is sometimes considerable discussion about how various terms are used, both within and between disciplines. In some cases, there appears to be little agreement over the meaning of some terms within a community. For example, the terms: 'goals', 'aims', and 'objectives' are used and defined differently in the literature (Gronlund, 2000; Noddings, 1995; Peters, 1966)

There are also some striking differences in the terminology used by these two groups of experts. In some cases they use the same words but mean different things. This is a source of difficulty, which must be addressed (Shaw & Gaines, 1989). A translation between ID & GD is necessary if we are to design educational games that still feel like games. There is a certain amount of overlap in the terminology used, and in at least some cases there are subtle but important differences in the meanings of the words used (eg.

The way rapid prototyping is used is one example; the distinctions between iteration and recursion are different in education from those understood by programmers.).

To this end I have provided a glossary of terms below describing the way the terms are being used here. In some cases there are references or links to Wikipedia. It should be noted that these are not included as scholarly references, nor are they meant to imply that the entry referenced is 'correct', but simply to expand on my use of the term in this volume.

Terms that are 'new' are flagged. These are terms that have been coined and defined in this volume or by the author in another publication.

Artificial Intelligence (A.I.)

See also: a fairly good discussion on Wikipedia: http://en.wikipedia.org/wiki/Strong_AI
Step 1: Define "Intelligence". This is KEY, and, to my mind, still open for debate. Until we can agree on a common definition for intelligence, there can be no common description of *artificial* intelligence either.

> "We could define the intelligence of a machine in terms of
> the time needed to do a typical problem and the time
> needed for the programmer to instruct the machine to do
> it." John Nash, 1954

> "I tell my students that artificial intelligence is a property
> that a machine has if it astounds you." Herbert Freeman

Can we separate intelligence from consciousness; from awareness; from free will?

Strong vs Weak AI:

While I doubt you will find agreement even among the so-called experts, people dealing and working with fall roughly into two categories: the "believers" or Strong-AI proponents, and the non-believers, which are the 'Weak-AI' folks. Since there is no conclusive proof behind most of what is done in AI, the discipline often ends up taking on cult status (zealous devotion to a person, ideal, or thing). The believers will tell you it is only a matter of time before we create an intelligent machine. The non-believers are not so self-assured. While many strong-AI folks exist among computer scientists, the 'buy-in' to the religion is far greater among those who do not actually know how computers work . I think this is telling.

> Guy L. Steele Jr. [Distinguished Engineer at Sun], in reply
> to something Hofstadter (of "Goedel, Escher, Bach" fame)
> wrote in 1981. "There is a possibility that the physical

structure of the universe may be such that the only feasible embedding of intelligence - in a small enough space that you are not subject to speed of light considerations, and can interact with human beings in real time, at their natural speed - may be the biochemical one. In fact, we may run into problems trying to build electrical, silicon, or whatever computers out of other stuff than what our heads have been made out of, trying to get it into a small enough space that the pieces can interact quickly enough so that they can have conversations with us. That is a possible technical limitation that we shouldn't overlook in the debate."

Much of the optimism shown by 'strong AI' disciples comes from a lack of understanding of what is actually involved in making these things happen. The promise that voice recognition is just around the corner is a classic example. The AI believers have been making such promises for over 30 years, yet real, functioning systems remain mysteriously out of reach. The fact is, we still have nothing that is reliable enough to be usable. Perhaps an example will help put it into perspective: suppose an AI missionary claims his intelligent voice recognition software can achieve 98% accuracy. That sounds pretty good, doesn't it? Well, let's apply that to the words in a book. An average paperback novel contains roughly 8 words per line, 35 lines per page. On one page, we have an average of 8 X 35 = 280 words. If we got 98% of the words right that would mean we get 2% of the words wrong: or about 5 words per page. I would not be willing to read a book that had 5 words wrong per page - it would be too distracting. Still sound good?

NOTE: Intelligent agents ARE sophisticated macros. They are the same thing. One of the biggest barriers to real advances in machine intelligence may well be an inability or unwillingness to accept that sophisticated programs are still just programs.

It should not be surprising that we would be so willing to impose personalities onto our computers. Even with just a small amount of apparent social 'consciousness', people are apt to anthropomorphize our computer. We attribute personalities to our cars too - and our musical instruments, our weapons, not to mention our pets, no matter how lowly. Just because I have given my car a name does not mean that the car possesses some form of intelligence.

Centrality

Used in graph theory and network analysis, **centrality** is a measure of the relative importance of a node. There are various metrics used to determine centrality, and the two found by Hsi (2003) to be most useful to the ontology of a software application are Eigenvector Centrality, which is a measure of how many other nodes are connected both directly and somewhat indirectly to this one, and Betweenness, which is a measure of how many shortest paths from one node to another pass through this one. These measures help identify the core elements.

Conceptual Coherence

"Conceptual coherence is an attribute of conceptual integrity, described by Fred Brooks as the property of a system designed under a unified and coordinated set of design ideas.

It is the property of a computing application that measures the degree to which that application's concepts are tightly related." (Hsi, 2005)

Decorative Media Principle

The Decorative Media Principle involves creating a visually pleasing background and other decorations for a worksheet, website, etc. that is thematically connected with the instruction. For example, in the work the author does with the "Ducks in the Classroom" project, vocabulary and word games are created on a pleasing background – possibly a nest, words enclosed in images of eggs, duck footprints, etc. The principle, although unproven is that the decoration helps to increase interest and may also increase the conceptual coherence of the learning object. (Becker 2006a)

Diegesis

Diegesis, from the ancient Greek ("recounted story") describes narrative, in contrast with mimesis which deals with symbolism. Diegesis tells; mimesis shows. The term is also used to distinguish sounds in film and games. Diegetic sound is one that originated from within the film or game world - an 'actual' sound. It has a source visible on the screen or implied to be present by the action of the film or game. Diegetic sounds are those sounds in a game that the characters could hear, like gunshots, nearby animals or a radio. Non-diegetic sounds by contrast are those that the story or in-game characters would typically not hear. These are most typically the musical score, as well as music to set the mood or provide feedback about game states or narration. Non-diegetic sound comes from a source outside story space.

Digital Game Based Learning (DGBL)

Learning that happens through the use of digital (computer-based) games.

Education

There exist many definitions of education, from William James' "Education is the organization of acquired habits of conduct and tendencies to behavior." (1915, p15, Dover Edition 2001) through the current Wikipedia definition that "Education formally is a social science that encompasses teaching and learning specific knowledge, beliefs, and skills." (Wikipedia, 2006) with many more variations besides. There is no single, all encompassing definition for education. This leaves us with an obligation to describe our context each time we wish to use the term. For the purposes of the following discussion 'Education' is being used in a fairly narrow and formal sense, involving the deliberate facilitation of learning. Further, R.S. Peters, in Criteria of Education (1966, p 25) states that it is impossible to consider education without implying some worthwhile and desirable change in the person being educated. Education is value-laden. (Paragraph from Becker, 2006b)

Instructional Decomposition

The process of examining an interactive digital object, such as a video game, website, or application to determine what kinds of learning are required in order to use, navigate, or reach the end. [source: K.Becker; working definition - subject to change]

Instructional Design Theory

A set of scientific principles relating to instructional methods, learner characteristics, learning environments, and outcomes. Typically derived from or tested by empirical research. [source: http://www.hutchcc.edu/distance/glossary.htm][19/11/2006]

Instructional Ethology

Instructional Ethology is the study of the externally observable "teaching" behaviour from four perspectives:

the game's structure (which is addressed through ontological excavation adaptations);

its function or support;

the interaction;

the game's similarity to other games, which in turn speaks to notions of genre (classification).

In Instructional Ethology, the main guiding question is "How does this game support the learning the people can or must do in order to succeed in the game?" There are also perspectives of Software Ethology, and Game Ethology (in a ore general sense). One could also study any specific aspect of a game from an ethological perspective, so one could study a game's ethical ethology.

Instructional Goal

A general statement of learner outcomes, related to an identified problem and needs assessment, and achievable through instruction (Dick and Carey, 1996, p. 23). [source: http://www.hutchcc.edu/distance/glossary.htm][19/11/2006]

Instructional Materials

Print or other mediated instruction used by a student to achieve an instructional goal. [source: http://www.hutchcc.edu/distance/glossary.htm][19/11/2006]

Instructional Objective

A detailed description of what learners will be able to do having completed a unit of instruction (Dick and Carey, 1996, p. 119). Related Terms: Learning outcome, behavioral objective, performance objective. [source: http://www.hutchcc.edu/distance/glossary.htm] [19/11/2006]

Learning

Learning happens all the time: it is a natural condition of being human. It always involves some sort of change: change in what we remember, our skills, attitudes, or behaviours. Learning is neither positive nor negative. We can learn things that are useful or useless, life-saving, or dangerous, helpful or hurtful. In short, learning has no associated implications of moral, ethical or other value. Education, on the other hand does imply value, but need not result in any change, although in order to be deemed successful, it usually does. Education implies deliberate facilitation of valued learning which occurs over and above what is natural, and implies some persuasion (possibly even coercion) that is enacted on the recipient of this education. Now this is not meant to imply any negative connotations necessarily, as many individuals willingly accept and embrace many forms of education. This description is meant to distinguish between learning as a naturally occurring phenomenon and can be done to oneself, and education, which is deliberate, and can be done to others. (Paragraph from Becker, 2006)

Learning Object

The term "learning object," which arose in 2001, is still sufficiently new that a multitude of competing definitions abound. The Co-operative Learning Object Exchange (CLOE) defines learning objects as "any digital entity designed to meet a specific learning outcome that can be reused to support learning." David A. Wiley says "the main idea of Learning Objects is to break educational content down into small chunks that can be reused in various learning environments". [source: http://lt3.uwaterloo.ca/resources/glossary.php] [19/11/2006]

Learning Objective

Describes precisely what is to be learned in terms of the expected student performance under specified conditions to accepted standards. These learning objectives identify the mental skills, information, attitudes, or physical skills that are required to perform the terminal learning objective. [source: http://www.kenseamedia.com/encyclopedia/iii/interservice_procedures/glossary/gly013.htm] [19/11/2006]

Mimesis

Mimesis, a term from ancient Greece means imitation or representation, as opposed to diegesis narration or report. Memesis is an analogue style of communication that employs the whole body as an expressive device. Memesis manifests itself in behaviours such as: pantomime, imitation, gesturing, sharing attention, ritualized behaviours and many games. (Donald, 2001) Mimetic skill constitutes the missing link between ape and human culture. In contrast to episodic skill "mimetic skill rests on the ability to produce conscious, self-initiated, representational acts that are intentional but not linguistic" (Donald, 1991 p.168)

Microworld

A Microworld is a term coined at the MIT Media Lab Learning and Common Sense Group . It means, literally, a tiny world inside which a student can explore alternatives, test hypotheses, and discover facts that are true about that world. It differs from a simulation in that the student is encouraged to think about it as a "real" world, and not simply as a simulation of another world (for example, the one in which we physically move about in). Source: http://www.umcs.maine.edu/~larry/microworlds/microworld.html
See Also: Rieber, 1996

Qualitative Meta-Analysis

(Delgado-Rodríguez, 2001) According to Delgado-Rodriguez, meta-analysis has the following meaning:
"The prefix "meta" means behind or beyond, of a higher or second order kind. It can be defined as a systematic identification, appraisal, synthesis, and, if relevant, statistical aggregation of all relevant prior studies on a specified topic according to a predetermined and explicit method. "

Ontogeny

From biology, ontogeny is the change in an organism's behaviour machinery during development (as opposed to a change in its behaviour during development). Simple changes in behaviour may be situational while ontogeny is developmental ($\Rightarrow$ growth; structural or anatomical change) and changes even though the environment does not. So for example, a typical behaviour of livestock guarding dogs is to bark and make threatening movements when a predator such as a coyote is near the livestock they are protecting. The dog will behave differently with different kinds of predators (which is an example of the second form of change in behaviour), but an immature dog will often behave quite differently in these situations and have even been known to act like they are trying to invite the coyote to play. It is believed that immature dogs lack the necessary strength and skill to confront the potential predator so they try to distract it and entice it to move away from the prey. In this case, the behaviours, though quite different serve the same purpose.

Ontological Excavation

'Ontological Excavation', developed by Idris Hsi (2005). This is a technique for reverse engineering that uses the morphology, or external interface of an application to uncover the ontology of an application, or the application's "theory of the world". For example, a calendar application would embody a theory about how users schedule their time. There are five main steps to this process (Hsi, 2003):
1. Model the user interface in a morphological map of the application's interactors, displays, and containers.
2. Generate a list of morphological elements.
3. For each element, identify the concepts (entity types and attributes) that it invokes.
4. Through dynamic interaction with the application, identify the relationships between the concepts.
5. Model the concepts and relationships into a semantic network representing the application's ontology.
Since the object of this analysis is to yield instructional elements of the application rather than its ontology the process has been adapted.

Participatory Theater

A form of theater performance where the audience interacts with the performers.
Participatory theater

Serious ID

Instructional Design of serious games. Instructional Design specifically geared towards the design of educational games.

Teaching

teach 7tc)8
taught, teach$[ing 5ME techen < OE t+can < base of tacn, a sign, symbol (see TOKEN); basic sense "to show, demonstrate," as in Ger zeigen6
1 to show or help (a person) to learn (how) to do something !to teach a child (how) to swim"
2 to give lessons to (a student, pupil, or class); guide the studies of; instruct

3 to give lessons in (a subject) to someone; help someone to develop (a skill or trait) !teaches French, taught him self-discipline"
4 a) to provide (a person) with knowledge, insight, etc. !the accident that taught her to be careful" b) to attempt to cause someone to understand or accept (a precept or philosophy), esp. by one's own example or preaching !her life itself teaches nonviolence" (Webster's New World Dictionary & Thesaurus, 1998)

Teleology

In this work teleology is seen as the explanation of a phenomenon in terms of its end purpose. While this approach makes sense in studying software behaviour generally, one must be cautious to avoid trying to explain everything from this perspective. The potential pitfall of this approach is best illustrated by an example given by Lorenz himself:

> "The man is traveling overland in his automobile; the
> purpose of his journey is a lecture which he is scheduled to
> deliver in a distant city. The man is underway 'for
> lecturing'; his automobile, a means of serving the same end,
> is there 'for traveling.' … Then something happens that
> happens often; the automobile coughs, sputters, and stops.
> All at once the driver is most impressively presented with
> the fact that the goal of his journey is not what makes the
> automobile move." (Lorenz, 1981, p. 33-34)

Epigraph

If you want to build a ship, don't drum up the men to gather wood, divide the work and give orders. Instead, teach them to yearn for the vast and endless sea.

Antoine de St. Exupery

The will to learn is an intrinsic motive, one that finds both its source and its reward in its own exercise. The will to learn becomes a "problem" only under specialized circumstances like those of a school, where a curriculum is set, students are confined, and a path fixed. The problems exist not so much in learning itself, but in the fact that what the school imposes often fails to enlist the natural energies that sustain spontaneous learning.

Jerome Bruner, 1966, p.127

CHAPTER 1. SCIENTIFIC DESIGN TO PREVENT OVER-EDUCATION FROM

HAPPENING: INTRODUCTION

"Our schools have been scientifically designed to prevent over-education from happening…The average American [should be] content with their humble role in life, because they're not tempted to think about any other role." - *William Harris, U.S. Commissioner of Education, 1889*

Note: Portions of this section have been previously published in:
Becker, K. (2006a). Classifying Learning Objectives in Commercial Video Games. Paper presented at the Summer 2006 Institute - Linking Research to Professional Practice. (Becker, 2006a)

That people learn from games is no longer in dispute (Egenfeldt-Nielsen, 2005; Prensky, 2006; Squire, 2003) whether or not it would be counted as education (see glossary) is a separate question. Nonetheless there is increasing interest in the use of this medium as an educational technology and it would seem that the fundamental design structure of at least some kinds of games are believed to lend themselves to use in this fashion. It has even been suggested that 'good' games already embody sound pedagogy in their designs despite the knowledge that that incorporation was not deliberate (Prensky, 2006; Becker, 2005d, 2005f, 2006d; Gee, 2003). In order to take advantage of those aspects of "good" games that are conducive to both high engagement and effective learning, these games must be studied. That is the impetus for the current research.

Digital games are distinct from all other digital and mass media. They share qualities with many other forms to be sure, but also have other qualities that set them apart (Egenfeldt-Nielsen 2004). While most, if not all of the qualities that make a computer game "good" (i.e. popular, engaging, entertaining, etc.) can also be found in other media, there have been few, if any, other entities that have captured the attention,

time, and money of an entire generation the way games have. Given their popularity, it

would seem reasonable to conclude that there is some thing or combination of things that

make this medium distinct. In his seminal work on "intrinsic motivation", Thomas

Malone names four essential characteristics of good games: control, challenge, fantasy,

and curiosity. (Malone, 1981, 1980a, 1980b)

If games are distinct from other forms of media, then instructional design (ID) for

games is also distinct from ID for other media. The central argument of this work is that

ID for games must come **out of** games design, rather than being imposed on top of it.

And the synthesis of such an approach must come from a combination of understandings

of how to design games as well as how to design instruction. This was not the case with

"edutainment", and some feel this is part of the reason why, in the words of the kids who

have it inflicted upon them, most edutainment "blows". People designing "edutainment"

games (like *MathBlaster*) often just don't get that the learning must be integral to the

game itself, not an add-on or plug-in. That means that the instructional objectives must be

woven into the game design, not just the game application. With the possible exception of

those few truly talented masters, it is not possible to see the possibilities and limitations

of gaming without a thorough understanding of programming and software design, and it

is not possible to design a game that will deliver on its instructional objectives while

retaining that which makes it a good game without an understanding of learning theories,

their application, and instructional design theories. There need to be people on an

instructional games development team that know both, and if these are different

individuals, they must be able to communicate effectively with one another.

The challenge of integrating learning objectives with the delivery medium is far from new. In some instances, this combination of media and method is easier than others. For example, when designing worksheets for drill and practice, it is common to create a visually pleasing background connected with the current theme. In the work the author does with the "Ducks in the Classroom" project, vocabulary and word games are created on a pleasing background that connects with the words used in the exercise – possibly a nest, words enclosed in images of eggs, duck footprints, etc. This idea of 'decorating' a worksheet works well for a great many themes, and can be applied quite effectively and generically. Need a worksheet related to Louis XIV? Add some pictures, maybe a few quotes, and if skillfully done, we have added value, fun, even connections for the learners to capitalize upon. The same principle often works reasonably well for instruction delivered via a website – so long as the website is primarily organized as 'print transferred online'. Taking online delivery a step further, the principle still largely holds, even when there are various interactive elements on the website or CD. The Hatching Project Candling Tutorial is a case in point. It includes many images, video, and self-tests, and it has received many positive reviews from all over the world, but aside from the non-linear interconnections, it is still many orders of magnitude less complex than a computer game.

Unfortunately, when applied to fully interactive media (specifically games), what the author has dubbed as the 'Decorative Media Principle' does not translate well. It is simply not enough. The result is often a game that is little more than a wrapper for the instructional materials. Rather than incur the wrath of well-meaning, but misguided edutainment developers by giving specific examples, a purely hypothetical description

will be offered here. Imagine a game that starts off as many typical commercial games do, with cool images and some sort of backstory - you are the world's last hope, and must use your superhuman powers to save mankind, and there is of course some sort of quest or challenge that must be overcome - defeat the enemy, or recover the lost treasure. But then, when the gameplay reaches a crucial moment, a new screen pops up showing what any child over 6 can identify as an "exercise", and the world-saving task to be accomplished turns out to be solving a quadratic equation. The answer to this equation, for some thinly justified reason, is the key. Even though the resultant number has no connection to the rest of the story, it is some kind of magic number that defeats the enemy. Even worse, this 'embedded worksheet' looks nothing like the rest of the game – in fact, it looks very much like the paper worksheet that was used in the same class the year before. This is what has become synonymous with 'edutainment'.

To be fair, there are some wonderful examples of fun games that employ this principle effectively – to remain with the hatching theme, examine the kewlbox.com game called "Fowl Words". This game is little more than an interactive worksheet, but the artwork, sounds, and design make it a

Figure 1.1 Fowl Words Screenshot

Image source: http://www.kewlbox.com

great deal of fun. Part of what makes this particular game work is that it does not pretend to be more than the simple puzzle it is.

There are other multimedia applications that are also highly complex, such as the software support for Computer Supported Cooperative Learning, and the design of such

systems are also challenging. The design of one such installation is described by Marlene Scardamalia & Carl Bereiter (1994). Their work with computer-supported intentional learning environments (CSILE) showed that CSILE students outperform students in ordinary classrooms on measures of depth of learning and reflection, awareness of what they have learned or need to learn, and understanding of learning itself. The role of the technology in this case is to support learning activities, whereas the role of the technology in the case of games is to actually **be** the learning activity. If games for learning are to be taken seriously, they must be designed to work both as games and as learning 'objects'. The synergy must be complete and the current research aims to help in the process of finding out how to accomplish this.

Walking Backward into the Future

> Most of us prefer to walk backward into the future, a
> posture that may be uncomfortable but which at least
> allows us to keep on looking at familiar things as long as
> we can. *Charles Handy*

Note: This section has been previously published in:
Becker, K. (2006a). Classifying Learning Objectives in Commercial Video Games. Paper presented at the Summer 2006 Institute - Linking Research to Professional Practice. (Becker, 2006a)

Modern education continues to be condemned for not meeting the needs of our young people. Things keep getting worse, we say. At the same time, we complain about the shortcomings of the kids themselves. Kids today don't know how to pay attention (so we give them drugs like Ritalin). Kids have an apparent incessant need for "instant gratification". Kids don't know how to talk or write anymore. The complaints go on.

How much of this is true remains to be determined, but apart from the age-old complaints[1] that the younger generation does not appreciate the ways of the older one, there do seem to be some measurable and significant differences in the way today's young people work and learn. Even though we have learned a great deal about how people learn and effective ways to teach them, we still seem to be losing ground, at least with respect to formal instruction. There seems to be a mismatch between the educational system and the people it seeks to educate.

One possible explanation for this apparent disconnect between formal education and the target of our attention is that kids really are different from previous generations, although perhaps not quite in the ways we complain about (Prensky, 2001b, 2001c; Beck & Wade, 2004). According to a recent study (Beck & Wade, 2004), these 'kids', who now comprise a cohort larger in number than the entire baby boomer population, are indeed different in some very promising ways. This new cohort, called 'Gamers' by Beck and Wade, include those born after 1969. One of the things they share is that all grew up with computer and video games as an integral part of their culture – even if they didn't play. If true, a failure to acknowledge and understand these differences could result in a greater and greater divergence between how we teach and how the learners learn (Papert, 1998; Norman, 2001, 2002). Perhaps more than at any time since the development of the factory model for learning, a gulf is developing between the institutions of learning and

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[1] "The children now love luxury; they have bad manners, contempt for authority; they show disrespect for elders and love chatter in place of exercise. Children are now tyrants, not the servants of their households. They no longer rise when elders enter the room. They contradict their parents, chatter before company, gobble up dainties at the table, cross their legs, and tyrannize their teachers." ATTRIBUTION: Attributed to SOCRATES by Plato, according to William L. Patty and Louise S. Johnson, Personality and Adjustment, p. 277 (1953).

the learners themselves. It's not surprising that more and more kids complain that school

is a waste of time. For many of them, much of it actually is. The world that the kids have

been born into and must eventually inherit is a very different one requiring very different

skills for success than the world their parents were born into, or their grandparents before

them. Some aspects remain relatively unchanged – it seems kids have always complained

that school was boring or irrelevant. In and of themselves, knowing how to cope with

boredom and do things one doesn't like are useful things to know, and it doesn't look like

the world is changing enough to eliminate the need for these skills. Other aspects have

changed significantly, and the ramifications of these changes have by and large not been

accounted for in formal education. Perhaps three of the most significant differences are:

1. These kids have grown up with access to what seems like the entire world's
   knowledge through the internet[2];

2. They have the ability to communicate with anyone and everyone [3]with access to
   that internet regardless of age, station, or economic status;

3. The primary leisure time activity for young people in the developed world has
   become video game playing. In fact, the video game industry has now surpassed
   the movie industry in some measures, and some television executives are now

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[2] No generation before has had to cope with such an abundance of information. While this will not play a major role in my proposed work, it does figure into the picture. The gamers, perhaps more than any generation that came before it, need to develop critical analysis skills in order to sift through the information available to them. The processes that have so far worked reasonably well for establishing credentials and building reputations are no longer adequate, and new approaches must be developed. Part of this process can be observed as it evolves on weblogs and wikis. There are unprecedented opportunities for people to comment on the writings of others – organizations like the New York Times provide forums where readers can discuss articles, while others, such as SlashDot, provide more direct means to add your own comments.

admitting that video games are also affecting television viewership. ([Reynolds, 2004](#); [Pethokoukis, 2002](#); [Yi, 2004](#)) While parallels can and should be made between video games and other forms of media, including web-based applications, literature, film, and theatre, it must be recognized that Video games are different. Multimedia and games are interactive in a way not seen since before books became the dominant (learning and) communication medium (see Figure 2.1), and in a way that sets them apart from all other forms of media.

Background

> One does not discover new lands without consenting to lose
> sight of the shore for a very long time. *Andre Gide (1869-1951) French Novelist*

I have felt that there was an enormous unexploited educational potential in the game-like aspects of computers ever since I 'played' with a simple, physics simulation of a spring on a CDC Cyber 172 mainframe, using a Teletype terminal while still a freshman in 1977. As a result, I have been under this 'influence' my entire adult life.

In an article of the [Digital Research Association (DiGRA)](#)'s HardCore column in March 2007, [John Kirriemuir](#) wrote that "The last seven years have seen an increasing number of reports about the potential and actual use of computer games in education. These are often commissioned and produced by education or research support bodies" ([Kirriemuir, 2007](#)). While he admits that some are quite useful, he points out that we should really be past the stage where we feel the need to begin every publication with a generic section describing the current state of the world as it reflects digital games and digital game culture. "Providing an 'introduction to games' results in a load of flannel that

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[3] Witness the evolution of Wikipedia: http://en.wikipedia.org/wiki/Wikimedia and such developments as weblogs (blogs): http://en.wikipedia.org/wiki/Blog, and now video blogs like Peter Jackson's:

can be read in any of 10,000 other media. Text such as 'Many people now own a Playstation 2, which is made by Sony yadda yadda yadda' dates horribly (Kirriemuir, 2007).” While I agree with this claim, it leaves me at a bit of a loss as to how to introduce the work that forms the remainder of this volume.

We all know digital games have had an impact on western society, though we do not yet know what that impact looks like nor what its ultimate significance will be. The public (i.e. media) image of digital games tends towards the sensational and bears a striking resemblance to the kind of media coverage allotted to television when it was new as well as virtually every other new media form dating as far back as we can remember (Williams, 2005). What we are only beginning to understand is how to use this new medium of videogames for serious purposes, in other words, as a means of expression and communication. Some of this work is being done by the games industry itself which is involved in various endeavors. For example, “Square-Enix has joined with a leading Japanese textbook publisher to make teaching games, EA has licensed the Madden franchise to a coaching software company, Konami has partnered with West Virginia to rollout a DDR-based exercise program. It's not a very big leap to say every major development shop will have at least one serious game under its belt in the near future” (Sawyer, 2007). Other work is being done by groups as disparate as the military and the health industry. It is hard to believe that the notion of digital game studies as a discipline is only a few years old.

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http://www.kongisking.net/kong2005/proddiary/

Seems to me, that in a field as young as Digital Games, *every* successful thesis produced plays a role in helping to shape the discipline. We are not yet working with a medium that enjoys broad acceptance, so along with contributing new knowledge in the traditional academic sense, those researchers at the leading edge of the discipline also serve as disciplinary architects. In game studies, the active graduate students form a significant part of this leading edge. Evidence for this, at least in part can be seen by the number of recent books that have been inspired by theses: T.L.Taylor's work with communities in *Everquest* (2000, 2006b), Jesper Juul's work in defining and understanding videogames (2004, 2005), Ian Bogost's approach to videogame criticism (2004, 2006), and David Williamson Shaffer's examination of several educational games (1998, 2007) along with several others that, while not professionally published as books, are freely available on the web and are frequently cited (Squire, 2003; Egenfeldt-Nielsen, 2005). In addition to many conference and journal publications, graduate students have also delivered keynote addresses, and published book chapters. In education specifically this includes names like Simon Egenfeldt-Nielsen (at IT University of Copenhagen), Lisa Galarneau (at the University of Waikato), Kurt Squire (while at Indiana University), Constance Steinkuehler (at University of Wisconsin-Madison), and the author (at the University of Calgary).

Establishing the Terrain

Many diverse professional and academic domains come together to inform this work. It is interesting that when I began this work in 2003, it was necessary to explain these connections in a fair amount of detail - there was not a great deal of literature talking about why digital games were suited to educational uses. After considering how

to establish the terrain for the study of serious games for more than six months, it became apparent that the reason this proved to be so elusive was that I was not merely describing where this work fit in to an existing terrain; I was in fact defining an entirely new space. If I were proposing work on web-based instruction for example, or when adults learn better face to face as opposed to online, or even my original research plan, which was to look at mental models in Computer Science, then the terrain is relatively well-established, and there exists a recognized body of research upon which to draw, and build. The introductory chapters in these works would describe the already known background and then define the gap to be addressed. This was not possible in my domain in 2003. The terrain of my proposed work pulls together existing terrains in Educational Technology, Social Justice, Learning Theory, Cognitive Science, Computer Science, Game Design, Media Studies, and even Fine Arts - where no single one dominates the others - and establishes an entirely new field. This has not been done before. Given that is the case, the actual description of the terrain, and how it relates to Games in Education ultimately required more than one introductory chapter, and forms a much more significant part of the dissertation itself.

Each of the contributing fields has one or more known areas of study that are relevant to the study of Games in Education. Media Studies have an established terrain, and the study of traditional games in the context of culture, as well as film, theatre, and literature studies all form the basis for the study of computer games in that context, which is a very new, but nonetheless existing domain. It is relevant, but does not deal directly with learning. The study of computer games from the perspective of Computer Science is also well established and the basis for this is quite straightforward. It deals with the more

technical aspects of the design and implementation of games. It is also relevant, but also doesn't deal directly with learning.

In Educational Technology, simulation, VR, and other immersive environments, as well as collaborative, on-line, web-based, and other multi-media instruction, and various instructional design theories are all relevant. I will make the case that games are a distinct form of media, and require a separate treatment. This part does deal directly with learning, but there is no existing domain in Educational Technology that specifically concerns itself with games for learning, so this connection is new.

The study of Games in Education, even traditional games, has no currently accepted basis, and so existing areas must be extended in new ways. Learning through Play - which is closely related, but still not the same - has been given a certain amount of attention, at least in the context of early childhood development, and some of the noteworthy celebrities involved in the study of play and learning play a role, such as Maria Montessori, Jerome Bruner, and Seymour Papert. The relevant contributions of Friedrich Fröbel and Jean Piaget are also influential, and although there are numerous studies involving specific games used in educational settings, as well as studies of games in specific contexts (like sports, math skills, early literacy, some areas of science), there exists no general "Theory of Gaming" as applied to learning, let alone a Theory of Video Games. This implies that I and others like me are charting what amounts to new territory, even in the mapping of the terrain itself. The connections are almost all going to be new ones as we explore this terrain.

Normally in a dissertation, the terrain as described helps to delineate the "gap" to be addressed in the work itself. It describes what has already been done in the chosen

area of study and describes the position from which the proposed work proceeds. At the time this work was begun (2003), mapping the terrain was actually part of the contribution to new knowledge, as this work had not been done. The map of the terrain was itself a gap. As such, a map of the terrain and the resultant delineation of the chosen area of study within it constitute the creation of a new and potentially distinct sub-discipline within Educational Technology. However, it would be unfortunate indeed if the study of digital game based learning and educational game development became confined to a single discipline and though the current work resides primarily there it is hoped that the contributions of this work will be recognized in other areas too.

Why is now the time to study games in Education?

David Jonassen, in "Learning with Technology" (Jonassen, Peck, & Wilson, 1999) says that while learners are intelligent, tools, by themselves, are not. Students learn with technology rather than from it. Nonetheless, computers and multimedia are enabling technologies, or "MindTools" as Jonassen calls them (Jonassen, 2000), and it remains true that technologies can interfere as well as enable. There are some things not possible with certain technologies. Others offer the potential for rich and engaging scenarios, yet without expertise in how to create and produce these scenarios, the medium can be equally limiting, or even damaging. This can certainly be said of digital games, and ten years ago this area of research would not have been 'ripe', and could have like the 'edutainment era' before it have been damaging.

Google[TM] became an official corporate entity in 1998[4]. At that time the Internet was still in its infancy - unfamiliar to most people with the exception of academics and those involved directly with computers. In 1998 the author was teaching in a Computer Science Department and the programming language of choice was C++. Java[TM] had been announced just a few years before in 1995[5]. The hardware 'horsepower' and storage capacity had finally come of age in a way that made interpreted programming languages like Java[TM] a viable option. But even in Computer Science, the discipline that at the time represented the core of the digital game industry, there were only a handful of institutions offering courses in game development. In 2001 the Institution where the author taught offered the first game program in a computer science degree in North America (Becker & Parker 2007c). By contrast, in January of 2008, GameCareerGuide.com[6] listed 504 different institutions offering various game development programs in more than 35 different countries.

Now is the time to study games for learning, as now is when we are seeing a phenomenal rise in social gaming.

> "So this is the backdrop for the rise of social gaming: a decline in civic and shared spaces and a decline in real-world places to meet and converse with real people. As these go down, gaming goes up. Neither event is likely

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[4] http://www.google.ca/corporate/history.html

[5] http://java.sun.com/features/1998/05/birthday.html

[6] http://www.gamecareerguide.com The Game Career Guide website was founded by the CMP Game Group in August 2006 as the leading website specifically for students and educators in the game industry. The site has expanded from the already successful education coverage on sister website Gamasutra, is run as a complement to the Game Developer magazine's annual Game Career Guide issue, and now publishes daily news and twice-weekly feature coverage on the cutting edge of game industry education.

causing the other. Instead, here is a hypothesis about what
is happening: Humans, whose need for social contact has
never changed, find themselves with a desire for
community and social interaction but with fewer and fewer
real-world outlets. The demand for human connection has
been static but stymied by the real, it has moved into the
virtual. As a result, social ties have moved online as part of
a virtual community trend (Rheingold, 1998). As one of the
most popular online functions that bring people together,
games are a particularly important site of activity to
consider." (Williams, 2006, p.15)

Talk of digital games for learning seems to be everywhere now. The Association

for Educational Communications and Technology (AECT) featured several panels and

sessions focusing on games in education at its annual conference in 2006 and provided

even more in 2007. Most organizations that deal with the use of technology in learning

now feature articles on games and education and several publications have devoted entire

special issues to gaming (Journal of Design Research v5(2) 2006, British Journal of

Educational Technology v38 (3) 2007, AECT Tech Trends, v49(5) 2005, Journal of

Media Literacy v52 (1&2) 2005, to name just a few). Hardly a week goes by that one

does not find an article on games in newsfeeds devoted to education and formal

schooling. Large and highly respected organizations are saying we need to use games in

school. The recent report published by the Federation of American Scientists stated:

"There was strong consensus among the Summit participants that there are many features

of digital games, including game design approaches and digital game technologies, which

can be applied to address the increasing demand for high quality education" (Federation

of American Scientists, 2006).

Where I Came From and How I Got Here.

People see things through the lens they understand and/or are trained in and/or are

most comfortable with: I have a respected friend who is a set designer in the drama

faculty who has said that – to someone in drama, everything is set design.

Well, that got me thinking, and ….

for a computer scientist, everything is an algorithm.

to a musician, everything is a song.

to a writer, everything is a story.

to theater people, everything is a play.

to a film-maker, everything is a movie.

to an educator, everything is a lesson.

We are all biased and we all view the world through our own experience. This

helps us in some places and hinders us in others. My background in Computer Science

(as well as a lifetime watching and working with animals) has had an enormous influence

on the work of this thesis, and in this particular instance at least, it has been beneficial.

This work combines various aspects of my life and experience. I have spent 30 years as a

computer scientist, the same amount of time teaching people how to program (or trying

to), 10 years using digital games for educative purposes, and a lifetime avocation of

studying (primarily animal) behaviour. My nearly 30 years in computer science gives me

a perspective that few looking at the educational potential in games have. What that

experience brings to bear on the problem of designing educational digital games is a

thorough background in and understanding of the technical aspects of games – which

includes the design, the AI choices that are possible and sometimes necessary, and many

other technical aspects. My background in systems analysis and software design allows me to look at the design of a game from a different perspective from people schooled primarily in the social sciences and humanities, such as Kurt Squire and Jim Gee[7]. Finally, being a software designer and systems analyst first allows me to look at instructional design from a different perspective than many.

To my knowledge no-one has reverse engineered a game in the way I have done here: I am examining a commercial game as though it were an educational one ('education' used loosely here). I'm pretending that what needs to be learned in the game is something that we care about and I'm going to identify how that game supports the player/learner so they can learn what they need to.

Ultimately, an important goal of developing instructional design models, in addition to the immediate one of being able to apply them to the problem of creating effective instruction, is to be able to use them to help teach others how to design effective instruction. Taking that one step further, it then also becomes a question of how to teach people to teach instructional design. This line of thinking appears to have a certain recursive element to it which quickly becomes difficult to follow. To help visualize these processes, the author developed a number of theories and models, shown below.

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[7] That is not to say mine is necessarily better; it is different, and that difference can add new insights

Figure 1.2 The Cycles of Teaching Literacy
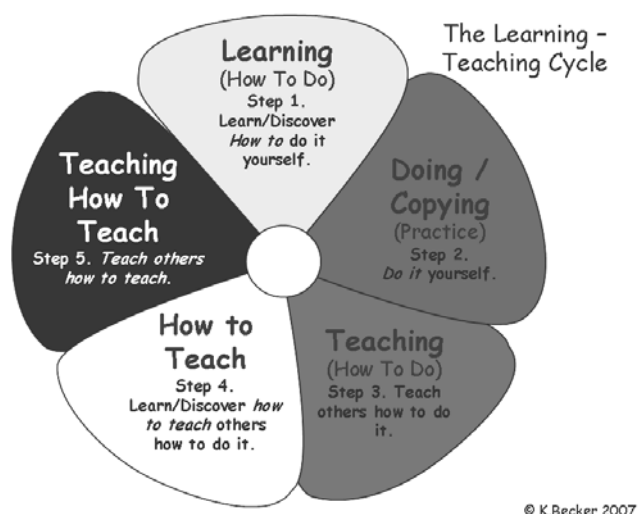
How people become teachers? This is of course a huge question that cannot possibly be answered fully here, but if one takes a highly abstract and overly simplistic view (Figure 1.2) it can provide one possible answer. This image depicts the phases people must likely go through in order to get to the point where they can teach someone else how to do something. This could be viewed as the Learning-Teaching Cycle.

Using the same abstract perspective, it is possible to map generations of teachers onto this learning-teaching

Figure 1.3 The Learning Teaching Continuum
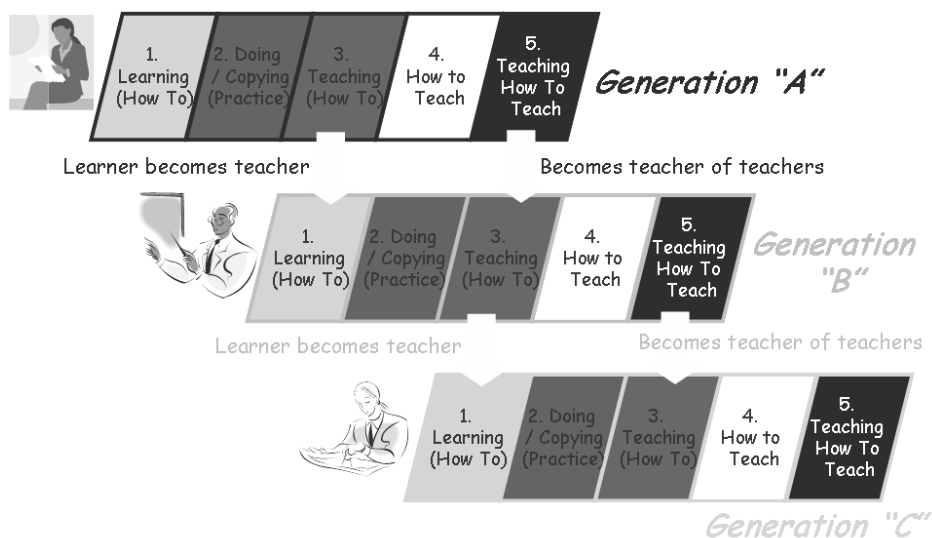
cycle, and see that there could be predictable points where one 'generation' connects to the next. This view is presented in (Figure 1.3) with the proposed Learning-Teaching Continuum (which involves learning to do a thing, then teaching others, then teaching others to teach). These relationships become important when we start to look at how to TEACH people to teach something.

Figure 1.4 Program Design / Software Literacy
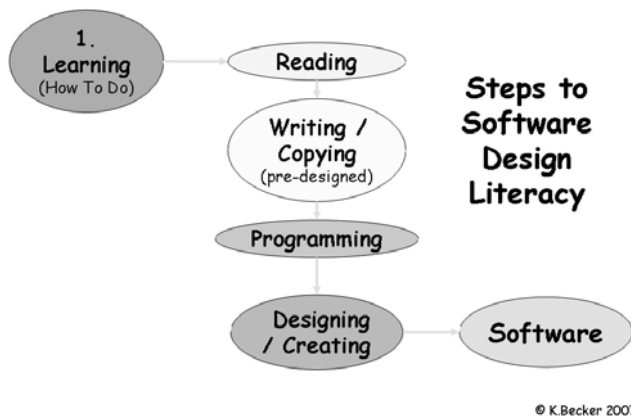
How people learn to design programs is shown in (Figure 1.4). The process is fundamentally one of acquiring literacy: one must learn to read programs, then to write them, often initially be copying them, then finally to create programs from existing designs, and finally gaining an ability to design and create programs on their own. Although these steps are not as clear-cut as shown in the diagram, these are the steps they must go through in order to become literate as software designers and learning to create computer programs.

Figure 1.5 The Learning - Teaching Cycle

The Learning – Teaching Cycle for Software Literacy

© K.Becker 2007
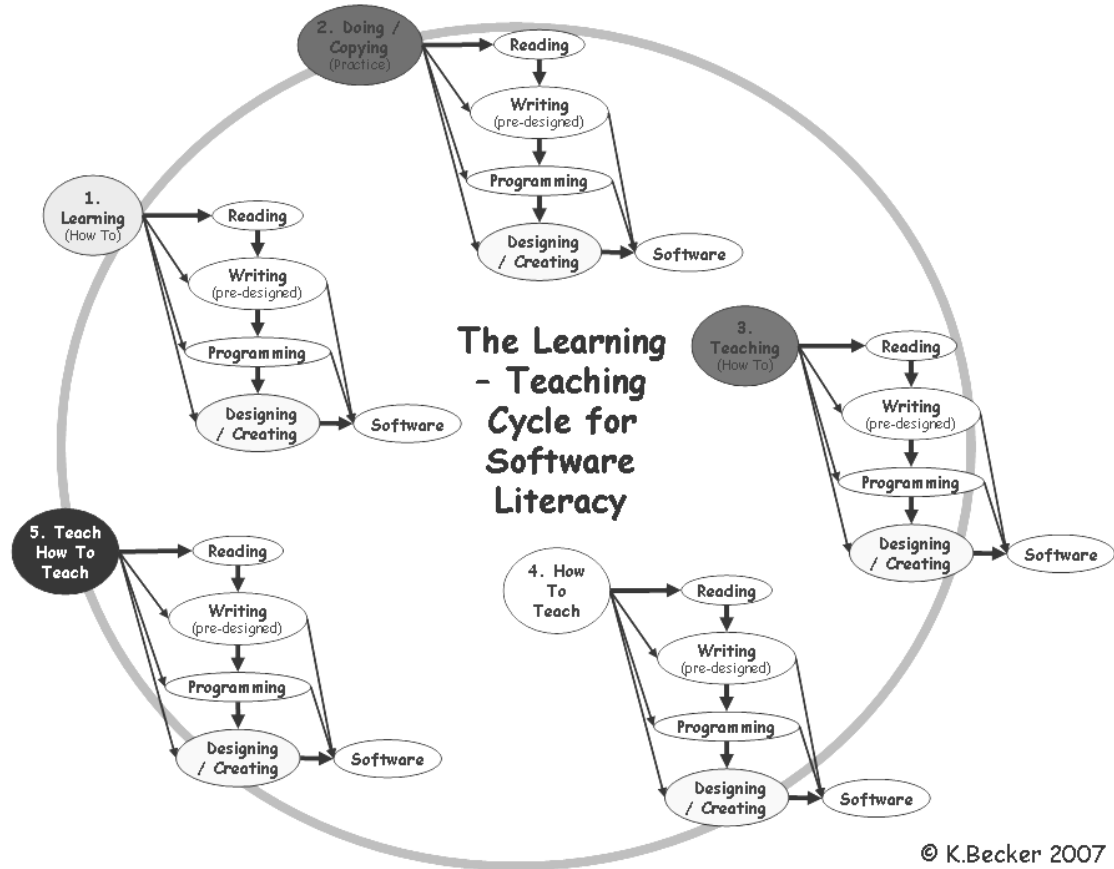
Building upon the models shown the next question could be how do people become TEACHERS of software design? This combines the first two models to produce the Learning-Teaching Cycle for Software Literacy (Figure 1.5). Enter games.

Now, digital games are, after all is said and done, still software, and as such examinations of game design must include some connection to software design. So when a computer scientist looks at how people learn to design digital

Figure 1.6 Game Design Literacy

Steps to GAME Design Literacy

© K.Becker 2007
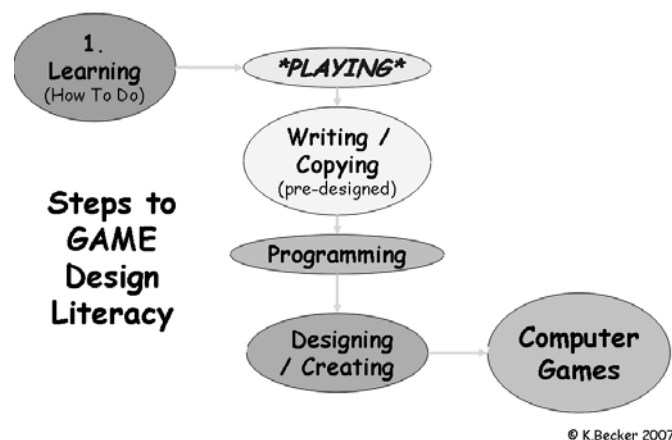
games, a PART of that includes the Steps to Games Design Literacy (Figure 1.6).

It would be silly at this point NOT to acknowledge that there is more to game design than just the programs - but this is true of all complex software - it does not cause it to stop being software. So at this point I will make a bold claim that you can't '***get***' games if you don't play them. Note that the first step to game design literacy in (Figure 1.6) is to **play games**.

The author has written elsewhere (Becker, 2007h) about ways we may help teachers to become more literate when it comes to digital games. Finally the focus of the current research is to help understand what is involved in the design of educational games. These require BOTH games literacy and educational literacy. A first visualization of this results in: Educational Games Design Steps (Figure 1.7).

Figure 1.7 Educational Game Design Literacy
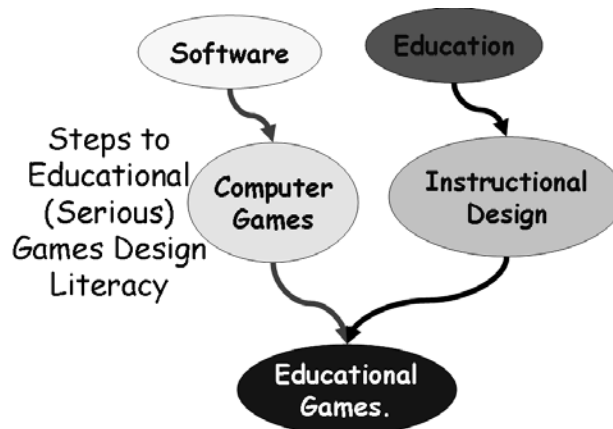
© K.Becker 2007

Problem Statement

> I have learned throughout my life as a composer chiefly
> through my mistakes and pursuits of false assumptions, not
> by my exposure to founts of wisdom and knowledge. ***Igor***
> ***Stravinsky***

The problem statement for research of this magnitude serves as a beacon – it helps the researcher stay afloat and keep from running aground. It is often purposefully large in

scope but allows the researcher to hold up their work against it to see how what they have done addresses this main question. It is the lens through which all subsequent research for this study is viewed. For this work, the main thesis question is:

How does a commercially and critically successful modern video game support the learning that players must accomplish in order to succeed in the game (i.e. get to the end or win)?

Professional Significance of the Study

> "While I'm still confused and uncertain, it's on a much higher plane, d'you see, and at least I know I'm bewildered about the really fundamental and important facts of the universe." Treatle nodded. "I hadn't looked at it like that," he said, "But you're absolutely right. He's really pushed back the boundaries of ignorance." – *Discworld scientists at work (*[Terry Pratchett]*, Equal Rites)*

This dissertation seeks to contribute to knowledge in both major and minor ways. The future will reveal which turns out to be which. These contributions are briefly outlined below with a comment on how this work is distinguished from previous work and introduced somewhat more fully in the following section.

1. **Games and Pedagogy** An explicit connection of game design to formally accepted theory and models in teaching and learning. Although others like Jim Gee and Marc Prensky describe general principles, including Gee's 36 principles for learning through games ([2003]), this work provides new knowledge by explicitly mapping known and accepted learning and instructional design theories and models to the design of commercial digital games.

2. **Report on How Researchers Choose Games for Study** A meta-analysis of the criteria used to select which games to study as reported by researchers. This is the

first study of its kind to conduct an explicit and detailed analysis of how researchers choose games for study.

3. **Data Fusion for Game Ranking** This study offers a new methodology for ranking "good games" using Borda Counts. This new approach can be used to combine any collection of rankings in a manner that is repeatable and verifiable. Again, this is the first time this approach has been used to rank games.

4. **Instructional Ethology** This is an entirely new methodology for game design deconstruction and analysis to extract information about mechanisms used to support learning. This methodology combines behavioural and structural analysis to examine how commercial games support learning. Further, this methodology can be applied to the analysis of **any** software system and offers a new approach to studying interactive programs.

5. **Study Results**

    1. New insights into how the design of several highly successful commercial games support players while they learn what they must learn in order to succeed in those games, and recommendations for how these insights can be applied in educational games.

    2. A design model, known as the 'Magic Bullet' that allows designers to visualize the relative proportions of potential learning in a game to assess the potential of a design.

    3. A preliminary instructional design theory for the design of educational games.

The Dissertation's Method

> One learns by doing a thing; for though you think you
> know it, you have no certainty until you try. **-** *Sophocles*

This work takes a two-pronged approach to supporting the main thesis, which is that we can learn about designing educational games by studying commercial games because people already learn from games and the best ones already do a pretty good job of teaching players what they need to learn in order to succeed in the game. The first part establishes a foundation for the argument, namely that accepted pedagogy can be found in existing commercial games. The second part proposes new methods for analysing games that can uncover mechanisms used to support learning in games, even if those games were not originally designed as educational objects. This second phase takes a hermeneutical approach as it is fundamentally a matter of perceiving a moving horizon, engaging a strand of dialogue that is an on-going re-articulation of the dynamically historical nature of all human thought (Ramberg & Gjesdal, 2005). Nell Nodding describes the approach as a "philosophical search for meaning that rejects both the quest for certainty characteristic of foundationalism and the nihilism often associated with Nietzche and sometimes with existentialism…. Hermeneutical work enlarges the scope of our vision, suggests new meanings, and encourages further conversation" (Noddings, 2007, p.76).

When researching what form this dissertation should take, many past and recent theses were consulted. The number is growing rapidly[8] but most are not local. When creating a dissertation reporting on the results of a survey or case study, the format for such a work is reasonably well understood. This was the case in Kurt Squire's ground-breaking work using *Civilization III* in a high school social studies class (Squire 2003). In

other cases the work presented is the result of several previous publications, as was the case with Constance Steinluhler's work with social learning in the game *Lineage II* (Steinkuehler 2005). Simon Egenfeldt-Neilsen examined the use of games in formal education as well as conducting empirical research in the classroom using *Europa Universalis II)* (Egenfeldt-Neilsen, 2005). Two other recent theses hit closer to home, namely those of Kym Buchanan who reports on a survey designed to measure receptivity to various designs of games (Buchanan, 2006) and William Watson's work involving formative research on an instructional design theory called Games for Activating Thematic Engagement (GATE) (Watson, 2007). All of these involved major contributions through in class or in-world (in Constance's case) studies and surveys, and none of them were able to serve as guides for work that took a more theoretical approach. As a result, the form of this thesis is a leap of faith involving largely theoretical work supported by what amounts to archaeological examinations of artifacts.

This work is presented in three sections: a beginning, middle and end. The game of chess is often played in three sections as well: the opening, the middlegame, and the endgame. Just as strategies vary in each phase of a chess game, so does the style of this report vary. The first three chapters make up the initial section and serve to introduce the terrain of this work. The mid-section spans from chapter four to chapter seven and contains descriptions and discussions of this dissertation's contribution to new knowledge, and the final three chapters summarize and conclude, first with the specifics

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[8] ProQuest (http://il.proquest.com/) has reported 11 new game PhD thesis in the period from November to December, 2007 alone

of the research, then with work that could be done to further this research, and finally most generally with some conjecture on the field of Serious Game Studies as a whole.

There are two chapters devoted to reviews of the literature, each tackling a different level of detail. Chapter two provides background on the role that games have played historically as well as the current digital game culture. This information helps to provide background for the framework of educational games, and how analysis of commercial game design can inform educational game design. This chapter is used to ground the framework but does not have a direct bearing on later chapters.

Chapter three provides an overview of games in education with particular emphasis on digital media. Although there are many similarities between non-digital and digital games, there are important differences and some of the key ones are outlined in this chapter. This is also where the simulation vs. games 'debate' is discussed as it has implications for the development of instructional games. Some of the major works and scholars involved in digital games for education are reviewed here.

Chapter four presents the first major new contribution which is to form explicit connections between accepted pedagogy and existing commercial game design. Games are a medium suitable for implementation of many of the major instructional models, as well as for the embodiment of many other major learning theories: goal-based, inquiry-based, multiple intelligences, elaboration theory, Gagne's nine events, ACTS (Adaptive Character of Thought.), and advance organizers. Chapter four explains how games facilitate the implementation of most (if not all) of the important concepts connected with effective learning: reducing/increasing anxiety as necessary; arousal; attention; communicating/eliciting specific attitudes; meeting various cognitive/learning styles;

fostering creativity; providing feedback/reinforcement; imagery; encouraging/facilitating learning strategies; mastery; memory; mental models; metacognition; motivation; schema; and sequencing of instruction.

Chapter five also presents new work, in the form of a meta-analysis of how researchers currently choose the games they use in their research, and proposes a methodology that can be used to choose games for research. Although studies and other research involving commercial games is growing rapidly there is still little attention being paid to how researchers choose the games they use, and very little discussion of rationales or justification for choosing one game over another. This chapter will discuss the growing importance of applying considered rationales to which games are chosen for study, whether it be for ethnography, classroom use, or anything else. A brief overview of how games are currently bring chosen for study is presented through a meta analysis of studies with games that were published between 2003 and 2006 in order to demonstrate that most published games studies do not include a supported rationale for the games chosen. The chapter will then present various ways that game choices can be justified, and propose and explain a data fusion technique that can be applied to game reviews and other lists in order to facilitate representative and defensible game choices.

The sixth chapter contains the other major new contribution which is a new way to analyse games. Education has borrowed from Anthropology for many of its qualitative approaches to research - ethnography. Computer Science has borrowed from biology for many new approaches to problem solving - neural nets, genetic algorithms, etc. The approach adopted in the work reported in this chapter borrows from biology too, but not the physiological aspects, rather the behavioural ones - ethology.

Chapter seven contains a report of results obtained from preliminary analysis using the new methodology. Five games were chosen as candidates for study, of which two had to be disqualified. That left three games that were used for analysis using both informal and formal approaches. Though these results are in many ways preliminary, they serve as proof of concept for the methodology and suggest ways it could be refined. With the same token, given the rarity of data on game design for education, some interesting similarities were found in the three games studied.

Chapter eight describes implications drawn from the work and outlines a preliminary framework for considering the instructional design of games. Several design principles are proposed.

This dissertation ends with two concluding chapters which are intended to compliment the two literature review chapters. As the introduction began with games and culture and then focused on games and education, the conclusion first examines future of the new knowledge contributions of the work in this volume and then reverts to a broader focus on the future of games in education.

Howard Gardner describes seven levers of change in his recent book on the art and science of changing minds (2004). In it, Gardner argues that all seven levers must be fully utilized in order to effect real change in the attitudes of educational institutions. They are listed here with a brief explanation of how it might connect with games for learning.

1. **Rational Reasoning**: Logically outline the pros and cons of the use of games for learning.

2. **Research**: Present data and relevant cases to support the argument.

3. **Resonance**: Create connections between desirable facets of education and those elements already embodied in games.

4. **Representational Re-description**: Make your point in many different ways.

5. **Resources and Rewards**: Use rewards as incentives to convince someone to adopt your view; make it easy to agree.

6. **Real World Events**: Use events from society at large to make your point.

7. **Resistances**: Understand the factors that cause people to reject your view. Such insights can make it easier for you to change their minds.

The establishment of a clear connection between best practices in game design and current learning theories is one more strategy that can be adopted to support the use of games as valuable tools for learning (Becker, 2005f). Arguing that games are pedagogically sound instructional technology addresses all of Gardner's levers, namely: reasoning, research, resonance, representational re-description, resources, and resistances. The connection between game design and sound instructional design needs to be made explicit, for the benefit of teachers currently in the classroom, for the benefit of the academics who ultimately create the programs and curricula that are used to train the next generations of teachers, and of course for the benefit of those who's futures are most at stake – our children. If digital games are sound educational technology, then children should be using them.

CHAPTER 2 LUBRICATING THE BODY AND THE MIND: A LITERATURE REVIEW OF GAMES AND CULTURE

Games lubricate the body & the mind. *- Ben Franklin*

This chapter provides a cultural context for games as learning objects, distinguishes between traditional and digital games, and defines games for the purposes of this study as part of a larger group of digital applications. Recent doctoral work on games has traced the history of traditional games in education (Squire 2003) and provided a detailed discussion of the history of educational media (Egenfeldt-Neilsen, 2005). The present work builds upon Squire (2003) and Egenfeldt-Neilsen's (2005) work, so a lengthy repetition of that work will not be presented here. Additionally, while the histories have not changed, the field of game studies certainly has, and though there is still a tremendous amount of basic research to be done, a great deal has been learned. Game Studies generally, and Serious Game Studies particularly are in such rapid development that many if not most resources published before 2000 are no longer relevant. Material related to modern digital games goes out of date very quickly because digital game technology has evolved and changed so dramatically that for the most part comparing digital games of the 80s and early 90s to those of today is like comparing a Model-T Ford to a SmartCar. For the most part, it is actually games that drive computer hardware development, from CPU speeds, to graphics processors, to external media like CD and DVD drives, to monitors and sound capabilities (Allen & Kim, 2005). Here is a sample of some of the developments that have been introduced since 1999: USB ports,

DVD, LCD Monitors, Flat Panel Displays, 64-bit words, >GHz processor speeds, WiFi, dedicated graphics processors, multi-core processors, and flash memory. The digital games industry has always taken advantage of the latest developments in computer hardware and software in order to produce new games, and the developments since the turn of this century have radically altered what is possible in terms of game technology. In addition, the ultrafast development of internet communication and networking has resulted in massively multi-player games that can support several hundred thousand simultaneous users, news that travels faster on YouTube than on television, and a myriad of social networking sites. The world of computers and technology has changed radically in the last decade, and therefore, so have digital games.

By way of presenting an historical path different from those already published, this chapter traces a subset of the history of the cultural significance of games. The reason for this is to help place digital games in several important contexts. First many claims have been made that games are a 'natural' way of learning (Gee, 2003; Prensky, 2001a, 2006; Aldrich 2004, 2005) and by highlighting our deep cultural and evolutionary ties to games and play this chapter provides additional support of that claim. Secondly, institutional resistance to games may be better understood this way, and institutional resistance is part of the reason for the present research: I am addressing this resistance by connecting the dots between a popular culture phenomenon and accepted and well-known education theory and praxis. Finally, for the purposes of this dissertation at least, it is important to distinguish between traditional and digital games. The games considered in this work are part of a larger group of digital applications and the methodology developed

here for analyzing commercial digital games can be applied to interactive software generally, but not to traditional, or 'predigital' (Murray, 2006) games.

Another goal for this chapter is to address several of Gardner's "Seven Levers of Change" (2004). This chapter specifically addresses the following three:

- **Representational Re-description**: *Make your point in many different ways.* My approach involves a synergy of natural history (ethology and evolutionary theories) applied to the study of design.

- **Real World Events**: *Use events from society at large to make your point.*

- **Resistances**: *Understand the factors that cause people to reject your view. Such insights can make it easier for you to change their minds.* Institutional resistance can be better understood by offering a connection between past media developments and digital games. Institutional resistance is part of the reason for my work: I am addressing this resistance by connecting the dots between a popular culture phenomenon and accepted ad well-known education theory and practice.

There are many possible reasons that systemic change in formal education is necessary, not the least of which is that the Industrial-Age paradigm has become counter-productive in the Information Age (Kemp, 2006). There is compelling new research that suggests that today's students have a different learning style, enabled by gaming. Beck & Wade (2004) surveyed 25500 young professionals and found that their approach to learning included 'aggressively ignoring' the structure and format of formal education, extensive use of trial and error, inviting input and instruction from peers, and an emphasis on 'just in time' learning. All of these traits are considered essential in modern business practice (2004).

Wolfgang Köhler's Chimpanzee

Animals can and do learn through play. When Sultan, a chimpanzee used by psychologist Wolfgang Köhler was presented with the problem of retrieving a banana that was out of reach, his curiosity and playfulness resulted in a fairly sophisticated solution (Köhler, 1963). According to the account given by Konrad Lorenz in *Foundations of Ethology*,

> "The ape was confronted with the task of reaching a banana with implements comprising two hollow sticks. One stick had to be inserted into the other in order to afford a tool of sufficient length. As long as the ape's interest remained centered on the banana, he failed to find a solution. He persisted in attempting to reach the fruit with the longer of the two sticks. Only when he had given up and had turned his back on the banana goal, and had begun aimlessly to play with the two sticks, did he succeed in inserting the one into the other. The moment this happened, he realized instantly that he now had the instrument required and he used it to get the fruit." (Lorenz, 1981, p.333)

> "It would seem that free play", says Lorenz, "is the prerequisite for all truly creative processes, for those of human culture just as for those of evolution. … The research that humans do has its place somewhere along the ill-defined borderline between exploratory behaviour and play" (Lorenz, 1981, p.334)

While the present research focuses on games, any discussion of games must include at least a passing mention of play. And before one can define 'game' it is helpful to try and define 'play', even though no universally accepted definition [currently] holds. *Webster's New World Dictionary & Thesaurus*, (1998 edition) lists 19 different meanings for 'play' when used as a verb. Konrad Lorenz names one quality that many activities most would recognize as play in both humans and animals have in common as being that the actions belong to a system of known function but are performed without that function

being fulfilled. He also postulates that basic science and discovery requires curiosity and play. (Lorenz, 1981). Brian Sutton-Smith (1997) concedes the difficulty of defining play: "We all play occasionally and we all know what playing feels like. But when it comes to making theoretical statements about what play is, we fall into silliness" (1997, p.1). Play is a paradox: at the same time it is and is not what it appears to be.

What Is a Game?

Is a game still a game when it is not being played, and can anything become a game if we play with it? While the next chapter contains a more targeted discussion of digital games in the context of education, it is useful to examine 'game' in more general terms.

Play and *game* seem to be terms that are inexorably intertwined, so the ambiguity of the first term affects the second. In his classic work, *Homo Ludens*, Johan Huizinga who wrote years before the first commercial digital game became known defines a game as, "a voluntary activity or occupation executed within certain fixed limits of time and place, according to rules freely accepted but absolutely binding, having its aim in itself and accompanied by a feeling of tension, joy, and the consciousness that it is different from ordinary life" (1950, p.28). Clark Abt defines games as "an activity among two or more independent decision-makers seeking to achieve their objectives in some limiting context" (Abt, 1970, p.6). Katie Salen and Eric Zimmerman (2004) say games are systems that can be considered in at least three ways: as rules (closed systems), as play, and as culture (the way the game exchanges meaning with the culture at large). And perhaps closest to the reality of the problem, Brian Sutton-Smith (1997) suggests that each person defines games according to his (or her) own perspectives. We all have some

sense of what constitutes a game, yet coming up with a clear and precise definition is difficult. The lack of a definitive statement on the nature of games should not however prevent us from examining games, or from using them as tools for other purposes.

Games, however difficult they might be to define [9] (Wittgenstein, 1973), clearly exist. Almost everyone, at some point in his or her life, has played a game. Perhaps, as Huizinga (1950) suggests, there are at least *some* distinguishing features that can be associated with **most** games. According to him, one of those characteristics, shared with play in general, is the existence of what he has termed the 'magic circle'. Games (and play) exist in a space somewhat apart from reality: a dimension of time and space [10]: 'the magic circle'. Within this magic circle things are permitted that cannot (or should not) happen in real life, yet we can learn things from games that we can apply to real life. Children of almost any age seem to understand that this special realm exists, and there is some evidence to suggest that at least some animals understand this too: dogs, when play fighting, will display most of the behaviours of a real fight, but no-one gets hurt. Further, dogs will even adjust their play for different individual dogs, as well as different individual people. Yet there exist certain understood rules, for it is also possible to observe when one player 'crosses that line' and steps outside of the magic circle. Suddenly, the dogs are no longer playing. Lorenz's colleague, Paul Leyhausen (Lorenz & Leyhausen, 1973) observed an important difference between play and 'serious behaviour':

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[9] Wittgenstein said that there is no one feature common to all games but that there exists a certain' family relationship.'

[10] "….You're traveling to another dimension. A dimension of time and space. A dimension of sight and mind. You're moving into a land of both shadow and substance. You've just crossed over into.." Sorry, couldn't resist…this is the intro to the Twilight Zone , Rod Serling's television series that ran from 1959-1964.

play behaviours lack the involvement of secondary reactions such as bristling of the fur. The distinction between a game and the real thing appears to be a fundamental one yet it is widely believed that skills and behaviours practiced through play are applied to real life. In one experiment, Irenäus Eibl-Eibesfeldt the human ethologist discovered that polecats who are not given the opportunity to play with siblings did not know where to bite prey and rivals or how to hold females during mating once they grew up (Lorenz & Leyhausen, 1973). Thus play and games can and do generate sometimes essential learning that transfers to real life, yet even animals distinguish between 'pretend' and reality.

One theory suggested by Huizinga (1950) is that when one plays a game, one willingly enters this magic circle, which affords the player certain freedoms not normally available to him or her. Among those freedoms are included the ability to experiment (with ethical, moral, and many other choices) in a manner not permissible in the real world, and with little or no real risk. This freedom endows the medium of games with a potential of highly significant value to education. From this perspective, it could be said that Albert Bandura may have been observing the influence of the magic circle in his famous Bobo doll experiments (Bandura, Ross, & Ross, 1961). Notions of the magic circle bring into question what imitations of aggressiveness towards a doll really says about an individual's aggressiveness in a real-life situation. It is not clear from the experiments whether the imitation of aggression in a play situation, i.e. within the magic circle, would imply that similar expressions are likely in real life. This notion is further supported when psychotherapists make use of this magic circle when they have children act out certain behaviours using dolls or other props, sometimes as a 'safe' way to express

certain feelings or inclinations that would be unacceptable if expressed in real life, and at other times to allow children to 'illustrate' experiences they have had. It is unlikely that this practice would continue if it was believed that acting out an event would generate the same kind of trauma as the real life event caused. The magic circle holds a special significance and although its exact definition and boundaries are unclear, adults, children, and some animals seem to comprehend its existence.

Play, Games and the Evolution of Culture

> "Now in myth and ritual the great instinctive forces of civilized life have their origin: law and order, commerce and profit, craft and art, poetry, wisdom and science. All are rooted in the primaeval soil of play." (Huizinga, 1950, p.5)

Traversing the necessary terrain relevant to this research requires that the disciplinary net be cast wide. A part of the story has to do with the role and place of games in society. Janet Murray (2006) has theorized that games have in fact played a significant role in the evolution of human culture and cognition.

One of the modern puzzles of evolutionary theory that continues to perplex cognitive scientists is the short time span between primitive man and his modern intelligent descendant. We still share most of our genetic material with bonobos and chimps, from whom we appear to have 'branched off' about 6 million years ago. Our last major cognitive step seems to have ended some 50,000 years ago. In the grand scheme of things, this is not very long. How did we get to be so smart so fast? Michael Tomasello (1999) has theorized that one of the most significant developmental steps has been our ability to understand fellow humans as intentional agents. It is what underpins symbolic communication, which in turn facilitates cultural learning. He believes that culture

ratchets cognition – that our brains and our culture co-evolve. Another piece of this puzzle is provided by Canadian cognitive neuroscientist Merlin Donald. According to Donald (2001) human cognition developed in four stages: 1) *episodic culture* which is where the apes still are (episodic culture is one that lives 'in the moment'); 2) *mimetic culture* which is a pivotal development [11] and includes symbolic communication involving mimesis; 3) *mythic culture* which is narrative and includes oral language, rituals and cave paintings; and finally, where we are now, 4) *theoretical culture* which includes an understanding of the world in abstract terms and is based on externally stored memory systems.

Mimetic culture is all that is required for the development of games. Mimetic skill constitutes the primary missing link between ape and human culture. In contrast to episodic skill "mimetic skill rests on the ability to produce conscious, self-initiated, representational acts that are intentional but not linguistic" (Donald, 1991 p.168) and this skill underpins games. Although he did not examine games explicitly, Donald does suggest that the progress of hominid cognition parallels the progress and complexity of game forms. Games are an inherent part of culture, and an innate activity for mankind.

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[11] It is at this stage that learning and reinforcement took the form of direct instruction, reciprocal games, and group ritual, "a collective act in which individuals play different roles" (Donald, 2001 p.175).

Old & New Media
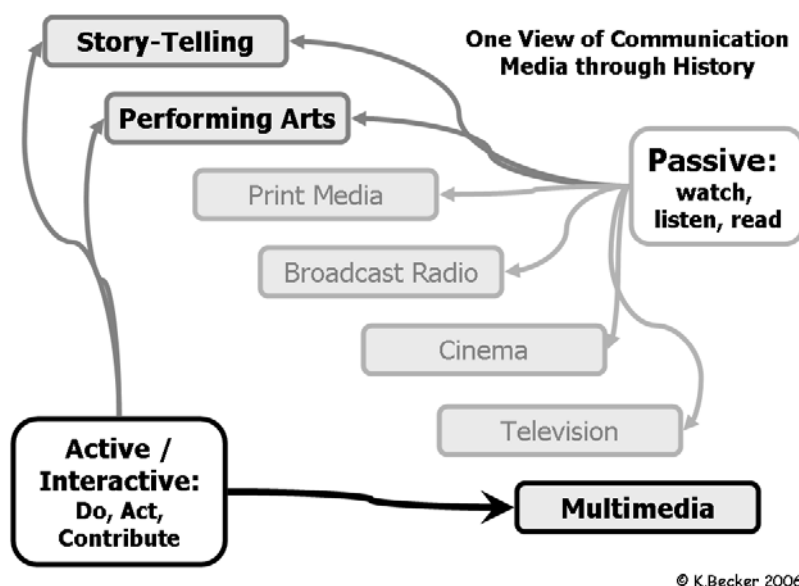
Figure 2.1 Progression of Communication Media Through History

Why are digital games unique in recent history? Although we have always made use of art as a form of expression (such as cave paintings) and there is good reason to believe that games predate language, when we became a literate culture (with the invention of the Guttenberg printing press) we began shifting from active and participatory media of communication and expression to more passive ones. Even performing arts and storytelling were once much more participatory than they are now (although there has been a resurgence in the popularity of participatory theater).

Digital games can be seen to have two primary antecedents: first traditional games, i.e. predigital games such as board games, card games, and live action role playing (LARP) games, and second other communication media such as television, film, and print. Both have had a significant impact, and yet digital games in some ways represent a Gestalt - they are more than a simple evolution of what came before. Games and game technology (which in this dissertation includes digital simulations) represent a

fundamental shift in how we can communicate - my generation grew up with film and television; the generation before mine grew up with print, film, and radio; the one before that primarily with print, as did the generation before it, and the one before that, …. We have been subjected to passive media (watch, read, listen) for a very long time now - it should come as no surprise that a medium as demanding of interaction as games should be met with resistance by those who have long been entrained to sit quietly and pay attention.

> "In a culture like ours, long accustomed to splitting and dividing all things as a means of control, it is sometimes a bit of a shock to be reminded that, in operational and practical fact, the medium is the message. This is merely to say that the personal and social consequences of any medium - that is, of any extension of ourselves - result from the new scale that is introduced into our affairs by each extension of ourselves, or by any new technology."
> Marshall McLuhan (1964, p.7)

McLuhan's now famous message reminds us that the medium inevitably affects the interpersonal dynamics of the society into which it is introduced. An example would be the way that online social networks have facilitated the strengthening and sometimes even formation of various communities – my recent subscription to FaceBook, for example has put me in contact with former students and others, some of whom I'd have had no idea how to contact otherwise. Such effects can not be disregarded when looking at digital media as a potential delivery medium for learning. Although he was referring to predigital games, McLuhan said that games are media of interpersonal communication. If we put the two notions together, then digital games are likely to change society. It is no wonder that there is resistance from the established institutions.

In spite of the potential benefits of both new media generally and digital games specifically, there has still not been broad societal acceptance. This reaction is by no means new. Dmitri Williams (2005a) attributes this resistance to several reasons: new media tend to invoke suspicion. Each major media development has been the object of similar reactions including newspapers, the telegraph, telephone, film, radio, television, and now both the Internet and videogames.

> "Typically, the actual source of the tension lies not in the new medium, but in preexisting social issues. The tensions over new media are surprisingly predictable, in part because the issues that drive them are enduring ones such as intra-class strife and societal guilt. Often, focusing attention on the medium is a convenient way of assigning blame while ignoring complex and troubling problems. Media coverage of new technology often generates a climate in which consumers of news media are terrified of phenomena which are unlikely to occur. Just as importantly, they are also guided away, purposefully or not, from complicated and troubling systemic social issues (Glassner, 1999)." (Williams, 2005a)

As a case in point, when Henry Jenkins published *From Barbie to mortal Kombat: Gender and Computer Games* in 1999 (Cassell& Jenkins) it was supposed to open up a dialogue about gender but instead it was quickly turned into a conversation about video game violence (Jenkins, 2006). Often the reality is different from the perception presented by the mass media. Digital games are a new medium, yet it will likely take some time yet before it is accepted as a legitimate or scholarly one.

> "We often assume that stories told in one medium are intrinsically inferior to those told in another. Shakespeare and Jane Austin were once considered to be working in less legitimate formats than those used by Aeschylus and Homer. One hundred years after its invention, film art still occupies a marginal place in academic circles. The very activity of watching television is routinely dismissed as

inferior to the act of reading, regardless of content."
(Murray, 1998, p.273)

The reactions to new media, including video games are complex but they are neither unpredictable, nor unique, and these reactions easily infiltrate institutional reactions, which tend, if anything, to congregate at the conservative end of the spectrum. As a result, it is important to find ways to connect video games to well-known theory. This research provides that connection to formal educational theory and practices that helps to lend educational credibility to digital game design.

Going Digital

Will Wright, creator of one of the best selling game franchises of all time - *The Sims* - discussed games as media in David Freeman's (2003) book, Creating Emotion in Games. The following are selected excerpts that speak to how games are distinct from other media like film or theater.

> "Comparing games to previous forms of media (which are, for the most part, linear experiences) can be both useful and dangerous. Useful, because by studying other forms, we get a good sense of what games are missing and how far they have to go in this important direction. Dangerous, because interactive entertainment is a fundamentally different proposition than its linear cousins, involving quite different psychological mechanisms."(Wright, 2003, p.xxxii)
> …
> "This is important because this empathic ability we seem to exercise so seamlessly is also the psychological engine that drives the thing we call "story." Story (in its many forms) seems to be an "educational technology" of sorts that we have developed over millennia that allows us to share experiences with one another across great distances of time and space. We can learn to avoid failures or achieve successes from people who are long dead across the world or who never existed at all. It's a technology that's entirely dependent on our ability to empathize with other beings."(Wright, 2003, p.xxxii)

> …
> "Games, on the other hand are most directly dependent on
> something else entirely: the concept of agency. Agency is
> our ability to alter the world around us, or our situation in
> it. We are able to act, and that action has effects. This is
> probably the first thing we learn as babies. This is the
> crucial distinction between interactive and linear
> entertainment." (Wright, 2003, p. xxxii)

The point Will Wright is making that is of direct relevance to this research is that games, while sharing some qualities with other forms of media are distinctly different and cannot be treated in the same manner as these other forms. While video games can be thought to conform to a relatively classic game model (Juul, 2005), they have also evolved beyond classic games into something that becomes more difficult to define with each new development.

There is a difference between non-digital and digital games - in terms of the play experience, what is required to support the game, what players can and cannot do, and possibly other things as well. For example, I can cheat at solitaire when I play with a deck of cards. I cannot cheat when I am playing solitaire on the computer, at least not in the same way [12]. There is also a whole different dynamic on the computer vs. with a physical deck. By way of personal example, I never had any interest in playing solitaire using real cards. I still don't, but I can play solitaire on the computer for hours. I would also suggest that playing Canasta with real cards and everyone in the same room is a different experience from playing over the net with just a computer simulated deck,

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[12] I could for example quit in the middle of a game and avoid having that hand included in my score, but that is also possible when playing a live game

which is also different from sitting someplace around a table (or what-have-you) in SL (Second Life) with other avatars.

A distinction needs to be made between 'pure' digital games, and digital version of non-digital games, as they are distinct. There are some games that only exist as computer games: *Tetris*, *Mario*, *Katamari Damacy*, while others are merely digital version of traditional games, such as Solitaire and chess. *Wii Sports* is part simulation of the real sports they represent, part something else [13]. For the purposes of this dissertation, I am primarily interested in 'pure' digital games. MMOs (massively multiplayer online games) have some similarities with both traditional paper-book-and-model RPGs (role playing games) as well as LARPs (live action role play), but there are also significant differences (player location, number of participants, non-player rule structures and enforcement to name a few) so these too fall under the category of 'pure' digital games.

Also, although there is some overlap, there is a different body of literature (and researchers) dealing with digital games as opposed to traditional games. Some see a continuum. For me, coming from nearly 30 years in computer science, it is not a continuum. Making it digital changes things. Table 2.1 summarizes those differences. These distinctions have implications for the design of digital as opposed to traditional games as well as how the medium can be employed for use as en educational technology. While understandings that inform the design of traditional games can also inform the design of digital games it is not a simple process of applying what is known to a new medium, like posting a story on the web that originally existed in print.

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[13] Watching those little baseball players run around when they have no legs is kind of odd, no?

	Digital	**Traditional (board games, card games etc.)**	**Live Role-Play**
Rule enforcement	hard-coded; can only be changed by changing the program (Yes, I know it is possible to create rule systems that can be player-edited – this just moves the 'enforcement' up one level of abstraction)	on the fly; player (or facilitator) controlled; this means they CAN be bent, broken, changed	
Rule Structures	pre-determined - can be monitored apart from players and facilitators	negotiable - monitoring is by players and facilitators	
Roles	accurate placement into context (complete with sights, sounds, behaviours)	imagined, personally mediated	
Play Space/Environment	dynamic; same for all players (Yes I know this can be altered, but this is not player created)	static; unchanging	imagined - each player has different view – personal
Play space/environment resolution	can be manipulated - can be high – universal/microscopic	static - physical game (board, pieces) don't change	mediated by individual imaginations (i.e. not shared)
Game Objects	can be autonomous	either inert or mechanical	imagined
Game Interaction (what people can do with / to the game)	is consistent across all instantiations of the game	consistent	each instantiation can be different
Players	there need only be one human player	all players/participants in traditional games must be human	

Table title: **Table 2.1 Digital vs Non-Digital Games**

Game Design

"A good game consists of a series of interesting and meaningful choices, made by the player in pursuit of a clear and compelling goal." (Falstein, 2006)

What do we know about game design? Although a thorough treatment of the topic of game design is well beyond the scope of this work, some discussion is essential as this research tackles the problem of studying the design of games. Further, while the present study deals with digital games as educational objects, these cannot readily be compared to other educational objects when it comes to the design process. The object most like games is in fact theater - and participatory theater at that, though in terms of budget and corporate risk, the closest industry is film. Game design budgets now often total tens of millions of dollars, and can be three to five years in development. This context of games as mainstream entertainment has both advantages, in that more and more middleware is becoming available for smaller producers to use, but it also has disadvantages, not the least of which is the expectation of richness and quality that gamers have come to take for granted.

Game design is still much more a black art than a science. "Black Art" refers to magic generally, but also stage magic specifically. Game designers do talk about their craft, but it is only recently started to be studied academically (in the last 5 or so years) with an eye to how one might teach it. As has been stated elsewhere, the number of game development curricula offered in higher education has gone from a very few to over a hundred in just a few years (Tobias & Fletcher, 2007). Game design details are still largely viewed as proprietary concerns and as such details tend not to be well published. However, a quick search on Google Scholar using the phrase "game design" turns up over 5500 hits, with over 800 published in the last year alone. Raph Koster suggests that games are all about learning - people tend to lose interest in a game when they have learned all they can from it (Koster, 2004). Chris Crawford observed that game design

has not really kept pace with game technology (Crawford, 2003). Although computer hardware has evolved dramatically in terms of speed, processing power, and capacity, the games being designed now do not necessarily offer better gameplay than those designed when he wrote his first book *The Art of Computer Game Design* (1982). He also notes that there is more to game design than game programming, although that is clearly a part of it. Along with Koster (2004) he says that game design is about *fun*. In a recent article, Popular Science Magazine (Ward, Cantor & Carey 2007) listed the ten biggest technical challenges for game designers:

1. Processing Power: Like re-creating the ceiling of the Sistine Chapel with a couple magic markers

2. Water: Like painting the sea—while it's moving

3. Human Faces: Like trying to impersonate a living person using a finger puppet

4. Artificial Intelligence: Like teaching 1,000 kids to think for themselves overnight

5. Light and Shadows: Like trying to reenact the first few verses of Genesis

6. Fire: Like holding air in your hands

7. Material Physics: Like predicting how sand will spill from a broken hourglass

8. Realistic Movement: Like teaching a rag doll to play dodgeball

9. True-to-Life Simulation: Like cramming the sum of all automotive engineering knowledge into a joystick

10. Motion Capture: Like training a computer to see the world as humans do

Make no mistake - these challenges are substantial, but the fact remains, none of them will make any difference if the gameplay is not compelling. The proverbial holy

grail of game design has not yet even been identified, let alone glimpsed, but claims have included innovation, replayability, sustained sales, character development, and being able to maintain the ideal level of challenge. When looked at a certain way, it is possible to relate each one of these to creating a compelling game.

A game development team may include dozens of professionals as diverse as programmers, musicians, and celebrity voices to name a few, but the game ***designer's*** role is to design the gameplay, which includes the rules and structures that create the player experience (Salen & Zimmerman, 2004). There is a longstanding tension between narrative and gameplay that may be resolved differently for each game designed, yet there is very little theory in traditional games from which one can build (Frasca, 2001). It has only been very recently that game design has been considered an academic subject that can be studied and taught. Those who design successful games are thought to possess some knowledge that those whose games fail do not. Indeed, it is hard to argue that leading edge game designers like Will Wright (creator of *The Sims* and *Spore*), Sid Meier (creator of *Cilvilization* and others), Peter Molyneux (creator of *Black & White*), or Shigeru Miyamoto (creator of *The Legend of Zelda*, *Donkey Kong*, *Mario* and others) seem to understand the essence of good game design, and yet none of them have focused on the technical challenges described earlier in this section. Ultimately many notions about how to go about the game design process come from computer science and software engineering. Unfortunately, these disciplines have yet to solve many of these current problems so borrowing from their unverified methodologies might be foolish. It would seem that there is still much room to study the design process and develop new theories and models.

Serious Games

What is a serious game? Caillois ([1961](#)) claims that a game one is made to play stops being a game, Huizinga ([1950](#)) suggests that play and seriousness are opposites, and yet the qualities described by gamers to be the most desirable are what Csikszentmihalyi ([1991](#)) calls "optimal experience", or flow.

In 2002, Ben Sawyer produced a report with the support of the Woodrow Wilson Foundation with a goal of starting a conversation on "to create a better understanding of how commercial game and simulation developers, practices, and technology can be utilized by a wider field of organizations that build and apply models and simulations in the area of public policy ([Sawyer, 2002](#))." He described such games and simulations as 'serious games'. Thus, the serious games phenomenon isn't just about education - it's about tackling major social issues and making players reconsider their opinions through games. The original credit for the phrase goes to Clark Abt ([1970](#)) who wrote a book long before digital games became popular about (traditional) games played for serious purposes. Ben hosted the first Serious Games Summit as part of the annual Game Developer's Conference in 2004.

Some would suggest that *all* games are serious. Developers and players certainly take their games seriously ([Michael & Chen, 2006](#)). A sentiment that they share with most people involved in the study, design, or development of serious games is that entertainment and education often overlap.

The use of games for education, while still not widespread in formal schooling [14], seems often to be the angle that receives the most attention in the media when serious games are discussed. Some use the medium to communicate ideas intended to persuade in games such as *September 12*, *Balance of the Planet*, and *Take Back Illinois* (Bogost, 2007). Some of Ian's games have achieved the landmark distinction of being published by the New York Times AS stories. In other words, the story is not being written *about* the game, the game is being used to tell the story.

The key topics discussed in this chapter place digital games in the larger landscape of media, all of which have been used for cultural and other communication and expression. Chapter Three focuses on the medium of the videogame, its current place within the realm of formal education, and its specific location within the terrain of educational technology.

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[14] This may be an overstatement - there are some schools where computers are barely used at all, and many where *all* games are expressly prohibited. In that sense, little has changed from Henry Jenkins story about his son's experiences as re-told in the next chapter.

CHAPTER 3. DISTINCTIONS BETWEEN GAMES AND LEARNING? A
REVIEW OF THE LITERATURE ON GAMES IN EDUCATION

> Anyone who makes a distinction between games and learning doesn't know the first thing about either. *- Marshall McLuhan*

There is already an extensive and growing body of literature in the area of games and education. Recent reviews of the literature and extensive research reports (namely, Kirriemuir & McFarlane, 2004; Mitchell & Savill-Smith, 2004; Ellis, Heppell, Kirriemuir, Krotoski & McFarlane, 2006 Freitas, 2007), as well as several significant (self-published[15]) dissertations (Squire, 2003; Egenfeldt-Nielsen, 2005), provide an overview of both traditional and digital game use in formal educational contexts. Therefore, instead of attempting to represent the history of each of these fields, this chapter provides a summary of the main findings of the major literature reviews and highlights a few key resources for understanding the link between games and education.

Educational Media

In many ways, the use of computer games in schools has followed a similar pattern as the use of other media: optimism followed by 'rampant' appropriation with little consideration for that media's distinguishing characteristics. Instructional films peaked and crashed as educational technology at least partly because of some of the same issues that plagued television a generation later, and which now appear to be affecting digital games. There was widespread skepticism in combining entertainment, commercialism,

and education, and film was considered 'low culture' and insufficiently dignified for formal education (Egenfeldt-Nielsen, 2005). Larry Cuban (1986) argued that there appears to be a cyclical pattern of enthusiastic early adopters, lack of support and institutionalization, and then use drops off when it comes to the use of instructional technology like television, radio and computers. Educational television has undergone several renaissances where revival has usually been brought about through legislation. There were numerous educational programs available throughout the 1970's; they all but disappeared in the 1980's and have returned again largely supported by specialty channels available by subscription.

Games are once again experiencing a re-birth as learning technologies, but this time it seems to be paralleling a far more widespread interest in the use of games and game technology. The previous chapter introduced the notion of serious games, and indeed games are being used for training and education by militaries, the health industry (everything from surgical training to diabetes education, to supportive treatment of Alzheimer's), non-profits (to raise awareness and prompt action) and more. Nintendo™ is now advertising its DS handheld console to casual gamers and promoting its new game *Brain Age 2* as a game that "trains the brain in just minutes a day". It appears that a shift towards a more positive public perception of video games may be occurring that may foster broader acceptance than was experienced during the 1980s and early 90s.

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[15] Although these dissertations have not been formally published, they are freely available on the web and add to the body of knowledge in this still rapidly evolving field.

Traditional Games in Education

> One learns by doing a thing; for though you think you
> know it, you have no certainty until you try. *- Sophocles*

Margaret Gredler ([1996](#)) places digital games as an evolution of traditional games presented using modern technology, yet as was seen in the previous chapter ([Table 2.1](#)) there are some critical differences which place digital games as a distinct medium. They do however share enough common features to warrant a brief treatment here. The following overview of the use of traditional games in education borrows heavily from Simon Egenfeldt-Nielsen's dissertation which presented quite a thorough picture of the field ([Egenfeldt-Nielsen, 2005](#)). Although the 'landscape' changes rapidly in digital games both in the areas of development and research, the same is not true of traditional games - new games are still developed, but the area of research is far less active and its influence on digital gaming is more of an historical one than an ongoing pressure.

The beginnings of organized efforts to use games for education in formal military training began in 1780 with *Helwig's Game* ([Egenfeldt-Nielsen, 2005](#)). Although militaries throughout the western world have been strong supporters of the use of digital games for teaching everything from skills to tactical and strategic to peacekeeping, access to their findings from studies w.r.t. effectiveness are limited. However, the sheer size of the investment and the fact that use continues to grow is a good indication that they are having enough success to justify their continued use.

Business colleges, especially in America, have used simulations and games as educational technologies for some time but this has not influenced educational gaming until quite recently. Often computer business games are labeled and marketed like any

other digital game and this may have also contributed to their being largely ignored as educational media. More often than not they are classified as COTS (commercial of the shelf) games.

Digital Games in Education

> "The invention of new methods that are adequate to the new ways in which problems are posed requires far more than a simple modification of previously accepted methods." Vygotsky , from Mind in Society, 1977, p.58

Digital games have been used to a greater or lesser extent in formal education since the early 80s, yet the differences between early educational games and current commercial games are so great that we cannot fairly consider them as a linear evolution. The rationale for this claim was explained in Chapter Two and will be discussed further later in this chapter (see section on Current Research). Modern digital games are little more than ten years old and the bulk of their evolution coincides with the other major IT developments in hardware, software and networking (Friedman, 2006). Although research on and development of computer games appeared promising a generation ago (Papert, 1980; Malone, 1981; White, 1984; Malone & Lepper, 1987), it's popularity appeared to wane through the 90s. Although the situation is changing, very little work exists on the use of modern digital games for education.

In the 1990's there was a Doonesbury-themed political campaign game that allowed players to experiment with strategies including things like where and when to schedule interviews. When Henry Jenkins' son played this game he was able to transfer what he had learned to the then active Dole-Clinton presidential campaigns in the U.S. (Jenkins et al, 2003). When he took the game to school to play during lunch he was

refused because games 'like that' (meaning non-educational) were not allowed. In many schools, little has changed. Institutionally sanctioned 'educational' titles are sometimes permitted, but commercial titles, regardless of potential rarely are (Kirriemuir & McFarlane, 2004; Ellis, Heppell, Kirriemuir, et al, 2006; Freitas, 2007).

Alice Mitchell and Carol Savill-Smith published a major review of the literature on the educational use of games in 2004 where they consulted eleven earlier literature reviews and examined 200 publications produced during 2000-2004 (Mitchell & Saville-Smith, 2004). The publications they examined included various uses of games for learning, including clinical practice and supporting reading and math but found that one of the most popular uses was as a for of experiential learning through simulations. The benefits of the use of games was not clear but it was noted that the literature base was still quite sparse. In that same year, John Kirriemuir and Angela McFarlane also conducted a review of the literature and also published a major report (Kirriemuir & McFarlane, 2004). They sought to explore several questions, including whether conventional games could be used in formal education and found that significant barriers still exist. Identifying the potential uses of specific games, persuading stakeholders, finding time to familiarize oneself with specific games and the persistence of irrelevant content which could not be ignored were all factors that conspire to keep games out of mainstream education. On the other hand, even though they found that many barriers were perceptual, they noted that there was a commonly held belief that games had the potential to become powerful learning tools because of their experiential nature. Becker and Jacobsen were able to confirm some of these findings the following year with a survey conducted with

area teachers, and two common barriers were lack of time and lack of support (Becker & Jacobsen, 2005).

Ellis et al published another review of the literature in 2006 where they found that there had been some progress in the adaptation of games for learning settings in the ensuing years (Ellis, Heppell, Kirriemuir, Krotoski, and McFarlane, 2006). They also found more use of COTS (commercial off the shelf) games than two years before but it was still not widespread. A major barrier remains the time it takes to become familiar enough with a game to know how to use it. This has been a common complaint and was one of the motivating factors in several workshops the author has offered (Becker, 2005b, 2007h), as well as an educational research graduate course on digital game based learning that the author designed and delivered (Becker, 2007a, 2007f) Ellis, Heppell, Kirriemuir, Krotoski, and McFarlane (2006) suggested that part of the solution was to open a dialogue between game developers and educators to reconcile the knowledge gaps. My own work connecting game design to known pedagogy is partially aimed towards this end (Becker, 2005d, 2005f, 2006d, 2006e, 2007e, 2008b).

Also in 2006 FutureLab and the 'Teaching with Games' project reported on a year long study intended to offer a broad view of teachers' and learners' attitudes towards and use of COTS games (Sandford, Ulicsak, Facer, & Rudd, 2006). They conducted national surveys as well as ten detailed case studies of COTS games used in four different schools. Among the key findings were that there is a large difference between students' and teachers' gameplaying habits, with 82% of students playing games and 72% of teachers **NOT** playing games. They also found that student motivation was positively affected by the use of familiar games and through having some autonomy when playing. Fixed-

length lessons were constraining; games did not need to be highly accurate to be beneficial, and they also found that meaningful use of games "within lessons depended far more on the teacher's effective use of existing skills than it did on the development of any new, game-related skills." (p. 4).

At the time of this writing, the most recent review is that of Sara de Freitas (2007) which reports on several case studies as well as providing a review of the literature. De Freitas found that many of the cutting edge examples of games use are currently being piloted in schools rather than in HE/FE, and she felt that it reflected a broader uptake of game-based approaches amongst younger learners. Another possibility is that it could reflect a more conventional approach in HE/FE (higher or further education) as compared to K-12.

What is an Educational Game?

> "We cannot define anything precisely! If we attempt to, we get into that paralysis of thought that comes to philosophers, who sit opposite each other, one saying to the other, 'You don't know what you are talking about!' The second one says 'What do you mean by know? What do you mean by talking? What do you mean by you?', and so on." ~ Richard Feynman (1963)

Are we building a game or a simulation? Are digital games more like traditional board games, face-to-face play, theatre, or something else? Is "Serious Game" a misnomer? Does it matter?

The question of whether we need to define 'game', educational or otherwise, is still open. While there are some educational researchers who embrace digital games as legitimate educational technologies, there are others who still struggle to understand what all of the fuss is about. However, disagreements about the definitions of these terms come

up regularly on online forums like seriousgames (part of the Serious Games Initiative and

gamesnetwork (part of DiGRA: The Digital Games Research Association) and from these

it is clear that there is no common understanding or agreement on how to define games,

with differences typically drawn along disciplinary lines. Education and Management

faculty (i.e. those who use and perhaps design games rather than those who make games)

typically insist that simulations are distinct from digital games and also that digital games

are simply an extension of traditional games, while Science, Engineering, and Medical

faculty along with the military sector typically classifying digital games as simulations.

Generally speaking, the computer simulation community considers digital games to be a

sub-category of simulations, and, more specifically, a subset of a particular subclass of

simulations known as discrete event simulations (Becker, 2006).

While these ongoing debates can sometimes be enlightening, the lack of a

definitive statement on the nature of games should not prevent us from examining games,

or from building them and using them as tools for other purposes. However, the way we

delineate the borders defining what is and is not a game does have implications for

research and development. A definition that is too broad, such as one that implies

anything we treat as a game becomes one is not useful, and a definition of game that is

too narrow, such as one that implies that all games must have competition and that

winning in games is always more important than exploration, excludes development

choices that might otherwise be beneficial. A development team must be clear on what it

is building and yet retain sufficient flexibility to allow innovation. Clearly the design

process is likely to proceed along divergent lines if one group envisions *Who Wants to be*

a Millionaire as their idea of a game and another envisions *The Elder Scrolls IV: Oblivion*.

On Simulation and Gaming

> You can know the name of a bird in all the languages of the world, but when you're finished, you'll know absolutely nothing whatever about the bird… So let's look at the bird and see what it's doing – that's what counts. I learned very early the difference between knowing the name of something and knowing something. ~ Richard Feynman

Margaret Gredler (1996, 2004) defines games and distinguishes them quite clearly from simulations. Those portraying a negative view of games (Clark, 2007, Alessi & Trollip, 2001) often cite Gredler's definition, yet others, like Kurt Squire (2003) suggests that the 'accepted' definition of game breaks down in light of modern digital games (Parker, Becker, & Sawyer, 2008).

According to the computer simulation community, (digital) simulations are based on models that have some degree of consistency - some set of rules we can describe, and some sort of purpose. Models are simply abstractions. There is no precondition that the model must be based on reality. For other communities like Education however, simulations necessarily model reality and are distinct from games, which do not (Gredler, 2004). Perhaps reality and abstraction are seen as mutually exclusive. They need not be, as it is possible to create a totally fabricated set of rules for a totally hypothetical system made up in a dream and it can still be modelled using a simulation. In other words, it's still a simulation, and assessments can be made to determine its validity, that is, how accurately it reflects the model.

The digital simulation community has been doing computer simulations since the beginning of computing around the second world war, and simulation, modeling and gaming have always been intertwined (Becker & Parker, 2006). Those of us from other communities, including education and even the military really only see the tiniest sliver of what the computer simulation community is doing so it is easy to get a skewed perspective, but we might be surprised at how many simulations went into the design and development of many of our everyday items, from cars, to drugs, to food. There are, of course many different types of simulations (stochastic, discrete, continuous, distributed,…). By this classification, most modern digital games fall under the subcategory of discrete event simulations. While by far not all simulations are games, in this community all games are simulations. This is easily explained by simply "looking under the hood" of a digital game.

If one looks at the algorithms of a fully digital game (i.e. one that is not a digital version of a traditional game) - those algorithms that actually make it behave the way it does - one will find that they are in fact simulations. While it is certainly true that most games have some aspects that classical simulations normally lack, that does not make them something other than simulations. If one adds software or devices to a computer to allow it to be used like a television, it does not stop being a computer. Similarly, if one adds a front end onto a simulation to overlay contest mechanics and allow people to interact with it as a game, it does not stop being a simulation. Interestingly, the computer simulation community does agree that there are some things about games that make them a distinct sub-class of simulations, so it's not as though it's all one amorphous happy

family. However, what they see as a difference has nothing to do with the game or contest elements - or reality vs. fantasy - it has to do with the use of peripheral devices.

Although the digital simulation community readily classifies digital games as a sub-category of simulations, perhaps a more germane definition comes from Sivasailam Thiagarajan (1998) the noted performance training designer who said that a simulation is "a representation of the features and behaviors of one system through the use of another" (p.35). Simulations, he says, are never accurate reflections of reality but always reflect someone's model of reality. In other words, no simulation can be truly realistic, and all are biased.

The Problem With Reality

The relativistic perspective implies that there can be no true objective reality. A potential difficulty with Gredler's insistsance on 'reality' in simulations is that many people take it to mean a reality necessarily connected to what we currently know about the world. This perception of the nature of reality is then further restricted by their reality. What we currently know about the world is, and always was a moving target. Data about the moon were hypothetical (i.e. not based on reality) in the early part of the 20th century; they were theoretical in the middle of the 20th century and finally observed in the later part of the same century. Does that mean that the computer programs written to model the moon were not really simulations until we had actually been there?

Here are some difficulties that come with hinging a definition of simulation on an adherence to reality:

Problem 1: Whose reality? What is reality? Objective? Subjective? There are no clear answers to these questions: philosophers have been grappling with this for millennia - in a way it is the central question of philosophy.

Problem 2: Perceptions of what is being simulated are contextual and depend on your perspective. One point of view may see *World of Warcraft* as a simulation of a social economy while another can only see a fantasy.

Problem 3: Any (complex) system can be viewed at various levels of abstraction. Different levels of abstraction reveal different aspects of the system. Tetris can be seen as a model of a packing problem, or as a wholly artificial game.

Ultimately, this reality problem may actually be at the core conflict between the way different groups use and perceive these terms (simulation / game). Computer scientists have little difficulty with the notion of "A reality"; others hear only "THE (read: **their**) reality". In Educational Technology, there is a notion that fidelity is a measure of 'realism' (Alessi & Trollip, 2001). A question that follows from this is, is something classed as real because we have seen and touched it, or because we "believe" it to be real? If so, a Venus 'simulation' cannot be a simulation because it is not real - we have never been there. Venus is a real place, but some of what we know is theoretically determined (i.e. not real), and much of it is deduced from indirect evidence. I would not class this Venus simulation as a game, but if games have to have competition, and simulations must be real, where does that leave the Venus model? Is it sufficient to be based on a mathematical model? What about quantum computing? Are we saying the models we implement of quantum devices and elements are NOT simulations? They are

largely based on mathematical theory, but we have no REAL quantum anything to

simulate.

A truly realistic computer simulation does not exist, although some flight trainers,

etc. are pretty good. Simulations all require abstractions, if for no other reason than to

make the model implementable. But it goes much father than that - abstraction permits

chess to be seen as a simulation of territory, and monopoly to be seen as an abstraction of

real estate development. It also permits *World of Warcraft* and *Everquest* to be

abstractions of society, and *Pikmin* to be an abstraction of resource acquisition. Snooker

is a physics game; sandcastles are architectural models. There really is no conflict with

this view. In fact, allowing games and simulations to be part of the same class broadens

the spectrum to allow for legitimate applications of models and activities in learning

situations that might otherwise never be considered.

Why it Matters

> The chief virtue that language can have is clearness, and
> nothing detracts from it so much as the use of unfamiliar
> words. ~Hippocrates

Unfortunately, when different expert groups use the same terminology but mean

different things, there is conflict (Shaw & Gaines, 1989), and progress not to mention

effective communication is impeded. While some groups can argue quite effectively that

games and simulations are distinct, when it comes to building serious games, as long as

games are seen as a different category from simulations, there is a tendency to design,

use, assess, and value them differently. It is hard to see how this is useful.

One consequence of a distinction between simulations and games is that some

educators use this as a justification to dismiss the educational potential of some games

because the story is rooted in fantasy. Tying simulations to reality limits their applications. It can end up being a way to restrict imagination and creativity. In some ways it is the grown up equivalent of telling someone she can't colour the trees in her drawing purple because real trees must be green. These distinctions often come as a result of value judgments that are being made. A particular application can be seen to have intrinsic merit due to it being classified as a simulation, but something else is "just" a game and therefore lacks merit. Placing games as a sub-category of simulations means we would now have to judge some simulations as OK and others as not, which is harder to justify, but which might turn out to be a more productive discussion.

Margaret Gredler is frequently used as a source for the definition of 'game': she is the author of the games and simulation chapter of the Handbook of Research on Educational Communications and Technology published by the Association for Educational Communications and Technology (Gredler, 2004) and defines games as "competitive exercises in which the objective is to win and players must apply subject matter or other relevant knowledge in an effort to advance in the exercise and win." She also claims that "bells and whistles" should be minimal and fulfill no important purpose. She finds it problematic when learners are led to enter incorrect answers for the sounds or graphics. These distinctions create a division between both the applicability and perceived value of a program used for instruction depending on whether it is categorized as a game or as a simulation. It also implies that trying some action in order to "see what happens" is undesirable. It is certainly possible that this is not a distinction between objects, but rather a design decision. If the reward for an incorrect answer outweighs that for a correct one, the gameplay is poorly designed (unless you are actually trying to tempt

them for a reason). Dr. Gredler also claims that players should not lose points for incorrect answers as this is not conducive to effective learning. One of the most significant lessons we are learning from game design is that participants both welcome and expect consequences to poor choices in a game. No risk, no gain. Games are a great way to acquire subject matter knowledge, not just to apply it.

For the purposes of the current research, games are treated as a subset of simulations as the theories, science, and technologies involved are all closely related. It is nearly impossible to draw unequivocal borders between these entites that would allow clear categorization of such offerings as *Civilization*, *The Sims*, *Animal Crossing*, *Final Fantasy*, *Grand Theft Auto*, and *Halo*. Reality is not a requirement for a simulation, but a consistent description of a model is. Games do not require competition, nor do they require a clear winner, but they do incorporate builtin goals, which is not a prerequisite for all simulations.

What is Edutainment (and What's Wrong with it)?
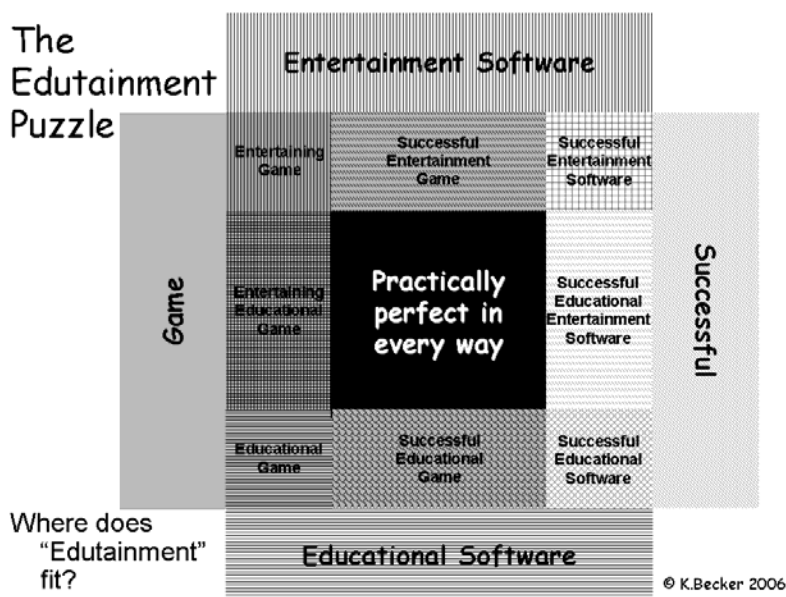
Figure 3.1 The Mary Poppins Factor

Figure 3.1 depicts the relationship between Commercial (entertainment) games, educational software, and educational digital games, where 'successful' is defined as meeting the objectives of the artifact. So, for example, successful educational software delivers on its learning goals and successful entertainment games are, in fact, entertaining. The 'sweet spot' for educational games is in the middle of the picture - a difficult state to achieve.

Alessi and Trollip (2001) claim that much elementary and middle school educational software gets marketed under the label of "edutainment", and that it often refers to repetitive practice activities. The term 'edutainment' has different connotations in different communities. Many discussions of "edutainment" put forward by game scholars add value judgments to the term (Buckingham & Scanlon, 2004; Egenfeldt-Nielsen 2005; Fabricatore, 2000; Leyland, 1996; Prensky, 2001a) – the conclusion seems to be that 'bad' educational software (by whatever measure) is far more likely to be referred to as edutainment than it is if it is somehow deemed to be 'good'. Mitch Resnick, a chief

proponent of active learning through the use of well-designed technology has a similarly

dim view of the term, as well as the notions typically espoused when the term is used.

> "So why don't I like edutainment? The problem is with the
> way that creators of today's edutainment products tend to
> think about learning and education. Too often, they view
> education as a bitter medicine that needs the sugar-coating
> of entertainment to become palatable. They provide
> entertainment as a reward if you are willing to suffer
> through a little education. Or they boast that you will have
> so much fun using their products that you won't even
> realize that you are learning—as if learning were the most
> unpleasant experience in the world.
>
> I also have a problem with word "edutainment" itself.
> When people think about "education" and "entertainment,"
> they tend to think of them as services that someone else
> provides for you. Studios, directors, and actors provide you
> with entertainment; schools and teachers provide you with
> education. New edutainment companies try to provide you
> with both. In all of these cases, you are viewed as a passive
> recipient. That's a distorted view. In fact, you are likely to
> learn the most, and enjoy the most, if you are engaged as an
> active participant, not a passive recipient" (Resnick, M.
> 2004).

The notion that fun and learning are somehow mutually exclusive is at least part

of the reason 'edutainment' has not been well accepted.

Simon Egenfeldt-Nielsen executes a fairly detailed analysis of edutainment

software in his 2005 dissertation, and defines them to include the following properties:

- **Little intrinsic motivation:** Edutainment relies more on extrinsic motivation
  through rewards, rather than intrinsic motivation. Extrinsic motivation is not
  really related to the game but consist of arbitrary rewards, for example getting
  points for completing a level. Intrinsic motivation would for example be the
  feeling of mastery from completing a level.

- **No integrated learning experience:** Usually edutainment lacks integration of the learning experience with playing experience, which leads to the learning becoming subordinated the stronger play experience. The player will concentrate on playing the game rather than learning from the game. One example is the skipping of text about the pyramids and going straight for the mini-games located in the game universe.

- **Drill-and-practice learning principles:** The learning principles in edutainment are inspired by drill-and-practice thinking rather than understanding. This means that you will constantly get arithmetical problems like 2+2 memorising the results, while not necessarily understanding the underlying rules that make 2+2 = 4.

- **Simple gameplay:** Most edutainment titles are built on a simple gameplay often from classic arcade titles or a simple adventure game with a world you can move around in.

- **Small budgets:** Edutainment titles are often produced on relatively limited budgets compared to commercial computer games and with less than state-of-the-art technology.

- **No teacher presence:** Edutainment never makes any demands on teachers or parents. Rather edutainment assumes that students can simply be put in front of the computer with the edutainment title and learn the given content or skills. There is no required teacher or parent guidance, help or involvement.

- **Distribution and marketing:** They are distributed and marketed differently than commercial computer games for example through bookstores, supermarkets, schools and family magazines.

(Egenfeldt-Nielsen, 2005)

Both of the preceding excerpts show a clearly negative view of 'edutainment' that has persisted since the early days of its use, but it seems quite clear that there exists no

fully shared meaning for this term. It would therefore seem prudent to avoid the use of the term.

Current Research

As discussed in Chapter 2, game studies is a field that is currently developing at lightning speed, at least as far as academic disciplines go. Although it may sound like an exaggeration nearly everything published in game studies and game technology areas prior to 2000 is no longer useful. Both *World of Warcraft* and *Second Life*, two massively multiplayer online environments with nine and 8.5 million subscribers respectively [16]), were released only a few years ago (2004 & 2003, respectively). Not only have gaming and game studies changed a great deal in the last few years, but academic and institutional attitudes have also evolved. As Tobias and Fletcher report in their recent article (2007), "five years ago fewer than a dozen universities offered game related programs of study; that figure has now jumped to over 190 institutions in the United States and another 161 worldwide". Clearly, the landscape has changed dramatically in recent years, and our research is working furiously to catch up.

Years from now, when we look back to the beginning of this century, we will mark sometime around 1999-2000 as the point in history when information technology came of age. Although I have been telling this in my classes for several years, there are in fact others who concur, and in his recent book, *The World is Flat*, New York Times columnist Thomas Friedman devotes considerable time to exploring the elements that came together at that time to bring about this revolution in how we communicate, work,

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[16] mid-2007 numbers

and socialize (2006). Games are a part of that, so the next section briefly explores the

current state of game studies as they relate to games for learning, and sets the stage for

the work of this dissertation. It is not intended to be an exhaustive inventory of research

on game studies. However, should readers wish further resources, there are two

substantial bibliographies of works related to game studies: 1) The Digiplay Initiative

maintained by Jason Rutter and Jo Bryce, and 2) The IEEE Game Bibliography

maintained by Jim Parker and Katrin Becker.

Theoretical Foundations of & in Educational Game Studies

Who is Researching Game Design?

What theories and models underpin educational game design and who is building

new theories & models? There have been many theorists, theories, and models that have

helped to form the foundation for the work of this dissertation, some of which have been

used and are discussed in Chapters four and six. Research on educational game design is

a very active field and much of what we are learning about the process has just come out

in the last few years with some of it still in press as this dissertation is written. With such

a dynamic field of study it is difficult to trace the development in any definitive way. The

following sections highlight a few key examples of older and breaking research that is

shaping how we approach the design of games for educational purposes.

Learning Through Design

As a somewhat separate but related category, learning through making games has

also been studied both in theory and practice. Yasmin Kafai along with other researchers

at M.I.T. were among the first researchers to focus on learning that happens through

making games for learning (constructionism) rather than playing games for learning (instructionism). She has done field work with children building games.

> "With thousands of instructional computer games on the market, including popular titles such as Math Blaster, we know little about which features make an educational game good for learning. A survey of the past 20 years of educational publications reveals a rather sparse bounty, in particular if one is interested in hard-core academic benefits rather than motivational or social aspects of playing games for learning" (Kafai, 2006, p.37).

More recently, Kafai and her colleagues have been examining the use of games and game environments and their application to students' understanding of a virtual infectious disease in relation to their understanding of natural infectious diseases. They found that students did not reason about the causes of virtual diseases in ways similar as natural diseases. They also found that integrating the curriculum around the simulation stimulated teacher–student discussions. (Neulight, Kafai, Kao, Foley & Galas, 2007) As in many other situations and studies, the game may be the focal point around which learning happens, but is not sufficient alone.

Seymour Papert is the creator of LOGO (Papert, 1980) and is responsible for much of the seminal work with children and computers in learning, as well as for the concepts of "constructionism", and "microworlds" (Rieber, 1996). On a more personal note, his *Mindstorms* book (Papert, 1980) was still very new as I completed my Master's degree, and the future of computer-aided instruction seemed bright indeed. Papert's research has evolved with the technology, and as a result his ideas remain current today. In fact, he is one of the current champions of the use of games for learning as well as using games design as a framework for improving current practices (Papert, 1998). His

current work involves learning through the production and creation of computer games. Says Papert, "Video games teach children what computers are beginning to teach adults– that some forms of learning are fast-paced, immensely compelling, and rewarding"(Papert, 1996).

In 1996 Amy Bruckman and Mitchel Resnick reported on groundbreaking work they did on a text-based virtual environment called MediaMOO (Bruckman & Resnick, 1996) that continues to this day. It is a professional community that is constructed by the members themselves. Although this idea is no longer new, this was one of the first virtual communities, and it adapted many of its ideas from the fan communities that surrounded video games of the time.

Carrie Heeter and Brian Winn (Heeter & Winn, 2007; Winn & Heeter, 2006) have been advancing the field with active playtesting and balanced approaches to addressing the gender divide in games designed for educational purposes. They suggest that while we can gain insights to the design of educational games by studying successful commercial games, we must be cautious not to borrow blindly from commercial games as there remain significant differences in the kinds of games boys and girls play as well as how much experience can be assumed. Through all age groups Winn and Heeter have found that boys play more and longer than girls do. If we simply adopt the styles and strategies found in successful games, there is a real danger of incorporating gender biases, which should have no place in most educational games. Based on their research, they suggest four characteristics that should be incorporated in games intended for classroom learning:

1. they strongly engage both girls and boys;

2. they accommodate diverse play style preferences

3. they provide support where needed for learners with limited gaming experience;

4. they result in deep learning through play (Heeter & Winn, 2007).

Further, they have also found that a chief obstacle of educational game design is finding an optimal convergence of the perspectives of the instructional designers, game designers, and content experts for a particular content domain in order to produce a set of learning goals.

In my own work as a computer science instructor, I have been using digital games, particularly classic arcade games as assignments to help novice students learn how to program and I have found that with few exceptions, the women I have taught enjoy making games even when they have little interest in playing them (Becker, 2001a; Becker & Parker, 2005a).

<u>Microworlds</u>

Although now more than a decade old, Lloyd Rieber's paper, "Seriously Considering Play" remains a key paper in Education that deals with play and games (Rieber, 1996). In it Rieber traces the history of play and its importance to learning. Expanding on Seymour Papert's original concept of 'microworlds' (Papert, 1980), Rieber outlined a design of a hybrid interactive learning environment which he eventually implemented and studied this as well as various design projects conducted with elementary and middle school students. He has found that much of the 'data' we have on the use of games and virtual environments is anecdotal and there is still little hard evidence of the effectiveness of games and other interactive media as learning

environments (Rieber, 2005). This is not to say there isn't any benefit, it's just that we still lack clear evidence. He suggests the use of design research and other mixed methods approaches.

The Game Object Model (GOM)

An early educational game development model is one proposed by Alan Amory and Robert Seagram in 2003 called the Game Object Model (2003), based on object oriented programming concepts. It is a generic game design model with several embedded conceptual models: the 'Personal Outlining Model' and the 'Game Achievement Model'. Although it claims to be a model that integrates education theory and game design, it does so at an abstract level by placing a requirement for learning objectives as part of the model. The models were used by Amory to help design games in several workshops, but there has been no use or testing of the model beyond the authors' own. It is somewhat disconcerting that the authors talk about focus groups and evaluations without ever mentioning a game that was developed this way. There are no actual examples and there is no data. This model doesn't really do much to address how to implement learning objectives, which to my mind is at the core of all instructional design. I think much like an instructional design begins with some kind of needs assessment that drives the rest of the process, instructional game design must begin with some goal(s) - what is it we want people to learn from this game? The rest follows from there. It needs some framework to be sure, but the learning objectives are key.

The conclusion of the paper mentions learning objectives several times (Amory & Seagram 2003), but it is difficult see how they fit in to the models provided. In one review by Ismael Rumzan (2002) of a later version of the same model, it was found that

"while this study is of good value in reducing the learning curve and development time for developers of similar projects, it lacks detail in the process of translating the learner outcomes to concrete and abstract interfaces as described in the Game Object Model. Furthermore, nothing is mentioned about user testing relative to the retaining of learner outcomes, which would have been valuable to evaluate the success of the implementation of this model. (p. 143) "

Digital Game Based Learning

Marc Prensky has been a vocal champion of the use of games for learning and maintains that games are uniquely suited to the learning styles developed in today's youth (2001a, 2006). He describes today's youth as 'digital natives' whereas those of us born before 1970 are 'digital immigrants'. Digital natives are those for whom most of what we (older generations) perceive as 'Technology' is a natural part of their world. He has championed the use of all sorts of games, commercial and otherwise and suggests, among other things that the following are some of the ways in which today's youth are different from the generations that came before: comfort with technology, multi-tasking, graphical, on-demand, and active (Prensky, 2001b, 2001c). Though it is known that there is still little empirical data on the efficacy of games in formal settings (Parker, Becker, & Sawyer, 2008), Prensky's most recent book contains a great many examples of places where games have been used to positive reactions (2006).

Gee's 36 Principles

The work of Jim Gee has been widely cited and his 36 principles have become well known (Gee, 2003) for connecting notions of what is considered good practice in situated learning to what is experienced while playing games. The fact that it was written

for a general audience rather than being targeted at fellow educators and researchers makes it a highly accessible introduction to the positive educational potential that can be found in modern games. While some of these principles would appear to be idealized extrapolations of what commercial games have to offer, they do present a fairly comprehensive set. Gee does make some references to well-known educational theorists such as Ann Brown and Jean Lave in his book (Gee, 2003), but the weakness in this work is that he does not give adequate credit to the theories and models whose ideas he borrows. On the other hand, this list was a significant impetus in the work described in Chapter four of this dissertation: namely, connecting game elements explicitly with known pedagogy and in that way giving credit to those theorists and researchers who have described instructional and learning design principles that have, even if unknowingly, contributed to the success of some of the games deemed to be among the masterpieces.

Table 3.1 Gee's 36 Principles
1 **Active, Critical Learning Principle** The learning environment is set up to encourage active and critical learning.
2 **Design Principle** Learning about and appreciating design and design principles are core to the learning experience
3 **Semiotic Principle** Using multiple sign systems (images, words, actions, symbols, artifacts, etc.)
4 **Semiotic Domains Principle** Mastering semiotic domains and participating in the affinity group or groups connected to them.
5 **Metacognitive Thinking about Semiotic Domains Principle** Active and critical thinking about the relationships of the current semiotic domain to other semiotic domains.
6 **"Psychosocial Moratorium" Principle** Learners can take risks in space where real consequences are lowered.
7 **Committed Learning Principle** Learners are engaged through a commitment to extensions of their real-world identities and virtual work that they find compelling
8 **Identity Principle** Taking on and playing with identities in such a way that the learner

	can explore the relationship between new identities and old ones.
9	**Self-Knowledge Principle** The virtual world is constructed in such a way that learners learn not only about the domain but about themselves and their current and potential capacities.
10	**Amplification of Input Principle** For little input, learners get a lot of output
11	**Achievement Principle** Intrinsic rewards exist for all learners, customized to each learner's level, effort, and growing mastery and signaling the learner's ongoing achievements.
12	**Practice Principle** Learners get lots of practice in a context where the practice is not boring and spend lots of time on task.
13	**Ongoing Learning Principle** The distinction between learner and master is vague. There are cycles of new learning, automatization, undoing automatization, and new reorganized automatization.
14	**"Regime of Competence" Principle** The learner gets ample opportunity to operate within, but at the edge of, his or her resources, so tasks are challenging but not "undoable".
15	**Probing Principle** Learning is a cycle of acting (probing); reflecting in and on this action, forming a hypothesis; reprobing; and then accepting or rethinking the hypothesis
16	**Multiple Routes Principle** This allows learners to make choices, rely on their own strengths and styles of learning and problem solving, while also exploring alternative styles.
17	**Situated Meaning Principle** The meanings of signs (words, actions, objects, artifacts, symbols, texts, etc.) are situated in embodied experience.
18	**Text Principle** Texts are not understood just verbally (i.e, in terms of definitions) but in terms of embodied experiences.
19	**Intertextual Principle** The learner understands texts as a family ("genre") of related texts.
20	**Multimodal Principle** Meaning and knowledge are built up through various modalities (images, texts, symbols, interactions, abstract design, sound, etc.), not just words.
21	**"Material Intelligence" Principle** Thinking, problem solving, and knowledge are "stored" in material objects in the environment.
22	**Intuitive Knowledge Principle** Intuitive or tacit knowledge built in repeated practice and experience counts and is honored. Not just verbal and conscious knowledge is rewarded.
23	**Subset Principle** Learning even at its start takes place in a (simplified_ subset of the real domain.
24	**Incremental Principle** Learning situations are ordered in the early stages so that earlier cases lead to generalizations that are fruitful for later cases.
25	**Concentrated Sample Principle** Fundamental signs and actions are concentrated in the early stages so that learners get to practice them often and learn them well.

26	**Bottom-Up Basic Skills Principle** Basic Skills are not learned in isolation or out of context.
27	**Explicit Information on-Demand and Just-in-Time Principle** The learner is given explicit information both on-demand and just-in-time.
28	**Discovery Principle** The learner is given opportunities to experiment and make discoveries.
29	**The Transfer Principle** Skills and knowledge gained in early parts of the experience are used in later parts.
30	**Cultural Models about the World Principle** Learners come to think consciously and reflectively about some of their cultural models of learning and themselves as learners, and juxtapose them to new models of learning and themselves as learners.
31	**Cultural Models about Learning Principle** Learners can reflect on cultural models of learning and on themselves as learners, and juxtapose them to new models of learning and themselves as learners.
32	**Cultural Models about Semiotic Domains Principle** Learners think consciously and reflectively about the cultural models about a particular semiotic domain they are learning, and juxtapose them to new models about this domain.
33	**Distributed Principle** Meaning/Knowledge is distributed across the learner, objects, tools, symbols, technologies, and the environment
34	**Dispersed Principle** Meaning/Knowledge is dispersed and can be shared with others outside the domain/game, some of whom the learner may rarely or never see face to face
35	**Affinity Group Principle** Learners constitute a group bonded through shared endeavors, goals, and practices and not shared race, gender, nation, ethnicity, or culture.
36	**Insider Principle** The learner is an "insider", "teacher", and "producer" (not just a consumer).

Some of these thirty-six principles appear to be variations of one another, so for example, the 'Text Principle' and the 'Multimodal Principle' could arguably be included as part of the 'Situated Meaning Principle'. Others appear to be reworded expressions of theories put forth by others, such as the 'Incremental Principle', which bears striking resemblance to Reigeluth's Elaboration Theory (Reigeluth & Stein, 1983). The principles are presented as a fait accompli, and in terms of advancing the field, it would have been nice to see some suggestions for how these principles might be verified or even some

suggestion for what kinds or percentages of games actually possess some or all of these principles.

Epistemic Games

David Shaffer proposes the notion of epistemic games, which are games based on professional innovation, in other words, the innovation enacted by professionals. In his book (Shaffer, 2006) he also examines several hypothetical games (like *'The Debate Game'*, and *'The Game of School'*), several custom made games (like, *'Escher's World'* and *'The Pandora Project'*) and others (like *'The Soda Constructor'*) meant to serve as examples. The idea of creating a virtual environment as a semiotic domain is a good one, but in order to succeed in formal education Shaffer admits that it would require a major reshaping of the current institutional structures. This work is necessary and important, but is unlikely to find it's way into schools in any significant way in the near future.

Activity Theory

There have been a number of people who have applied concepts of activity theory to game design. For an overview of Activity Theory, see Chapter 4 Activity Theory and Animal Crossing. Oliver and Pelletier (Oliver & Pelletier, 2004) designed a framework using activity theory's concept of contradictions that would enable them to track the process of learning without disturbing the natural flow of game play. Based on the work of Yrjö Engeström who connected learning with notions of solving contradictions. Contradictions are defined as blocks or tensions in an activity system where a subject is blocked from achieving their goal (Engestrom, 1987). In this game, one cannot progress to the next stage in the game without learning how to overcome a particular obstacle.

Overcoming a contradiction and being able to transfer the same strategy to a similar

situation is considered evidence of learning. Hence it is believed that analysing

contradictions in an activity system can be used as a framework from which to study the

process of learning in an RPG. This work has been advanced by Aida Hadziomerovic

(2006) under the supervision of Robert Biddle, who has also examined humour in games

using activity theoretic frameworks (Dormann & Biddle, 2006).

Mike Dobson and his colleagues at Simon Fraser has used CHAT (cultural

historical activity theory) as a framework through which to analyse activity in a

mutiplayer game as part of a user-centered design approach. They found that viewing

parts of the game as activity systems allowed for a focused examination of interaction

that was coherent for each part. While the process could become unwieldy if not carefully

organized, it did allow for targeted feedback from participants asked to examine the game

as it was being developed (Dobson, Mulligan & Ciavarro, 2005).

In chapter four (Chapter 4 Activity Theory and Animal Crossing), I use Activity

Theory in another way to analyse the design of a successful commercial game.

Games for Activating Thematic Engagement (GATE)

William Watson has taken a more structured approach and has developed a design

model for developing instructional games (Watson, 2007). His model proceeds as

follows:

1. Select a topic or multiple topics which can be connected by themes.

2. Define supported learning objectives.

3. Analyze intended learning environment, learner attributes, and design environment in order to establish available resources and constraints, conduct feasibility and return on investment analyses, and specify scope.

4. Define rules of context and overall structure of game, including story, goals, objects, supported actions, feedback, learner roles, and embedded values.

5. Promote desired learning opportunities through introduction of key obstacles, problems, and plot elements within the game and the implementation.

6. Design specific implementation guidelines and artifacts, including external activities and potential demonstrations of mastery.

7. Focus on engagement with the topic: incorporate and encourage competition and immersion through supporting learner control, challenge, fantasy, and curiosity within both the game and the implementation.

8. Design and develop the game through an iterative process which includes cycles of prototyping, evaluation, and redesign.

As with many other theories about the design of instructional games, this theory is still too new for there to be a body of evidence that either supports or refutes its value. In the single case examined in the thesis, it was found to be helpful which implies that further research is feasible.

Development of Games for Learning

Who is making educational games?

It has been said that there is a need for basic research to help quantify who is using games for education, in what ways, and with what success (Freitas, 2007), however one place where considerable progress is being made is in development: The Education Arcade, Games For Entertainment and Learning, The Contagion Game, The Digital

Media Lab, and several projects by Richard Levy to name just a few (several lists are available online, including SuperSmartGames.com). Prototypes are being produced, but finding the means and locations for formal testing is far more difficult and only a small proportion of those developing games have been able to test them in any formal way. In this sense the field of educational game development is much like SENG (Software Engineering), where many papers are published describing new approaches that are claimed to improve productivity, reliability, etc. but few if any comparative tests are ever completed or reported. In the case of digital games, the evaluation process is complicated by the fact that human subjects are involved, and finding formal settings where games can be tested is difficult.

With so many groups developing games (see Appendix A for a partial list), but many fewer actually analysing them there is a real danger of once again missing the mark by making unverified claims about the value of game-based education and risking a institutional rejection of the medium. This was one of the factors that contributed to the disillusionment with game-based learning during the Edutainment Era and one that we can ill-afford to repeat. Many forms of assessment cannot proceed without institutional help or at least willing subjects but one aspect that *can* be analysed in the absence of human subjects and formal settings is the game itself, and the methodology described in this research is one way of approaching such analysis.

Empirical Studies of Games for Learning

<u>Who is studying games in educational practice?</u>

What do we already know about the effectiveness of games in classrooms, corporate settings, or experimental settings? There is as yet very little data on the effectiveness of digital games in formal or even informal educational contexts. One area where quite a lot of work is being done is in the private sector, but very little of this data is formally published (Parker, Becker & Sawyer, 2008). For one thing, most developers producing games in the private sector have a vested interest in keeping details about their designs private for proprietary reasons - just like the commercial game developers. Make no mistake, game developers use play testing extensively - in other words they do try their products out on real people. Will Wright (2004) uses something he calls 'Kleenex testing' in his company Maxis - where the tester is unfamiliar with the game (i.e. has never played it) and is only ever used once.

The primary motivation for commercial and private sector developers is usually financial gain (or in the case of producers of training games, sales success). It is NOT disseminating or advancing knowledge and in fact they may have a justifiable interest in NOT sharing what they have learned.

In addition to the above, and in spite of the difficulties involved and the relatively short time frame available for performing good studies, some data are available. The Rosas et al. study (2003) looked at what happens when educational video games are introduced into the classroom and identified positive effects on learning and motivation. Specific Sony Playstation games were successfully used by Din and Calao (2001) to help with spelling and reading. A custom made time travel game called Life Challenge was

used as a means for teaching young adults about HIV/AIDS prevention (Thomas, Cahill & Santilli, 1997). Rieber, Matzko & Grant (2001) studied middle school students who were asked to critique educational games created by other students and found that important game characteristics for the students included story, challenge, and competition, but did not include integration of storyline with educational content or production values. Heeter, et.al. (2003) studied 12 space exploration games (4 educational, 8 commercial), and discovered the educational games to be less complex, shorter, easier to install and learn, and less challenging to play than the commercial games. The educational games also involved considerably less reading and typing, included fewer forms of fun, and contained less competition and fewer opponents than the commercial games did (Heeter et al, 2003; Rieber, Matzko & Grant, 2001). In another study, Amory et. Al. found that logic, memory, visualization, and problem solving were important elements for the college students involved. (Amory et al, 1999). Garris, Ahlers, and Driskell (2002) have offered an input-process-output model of instructional games and learning, but it does not address the perspective of the games design itself. Mitchell & Saville-Smith (2004) have an excellent summary of most of these and more, as do Balasubramanian & Wilson (2005). To learn more, refer to these two excellent summaries.

The Clark / Kozma Debate, Revisited

As has been true with any other technology introduced into schools to assist teaching and learning, digital games have their detractors as well as their champions. The the now-classic Clark/Kozma "media effects" debate (Clark, 1983; Kozma, 1994) has moved into the serious games space as revived in a recent editorial by Richard E. Clark

(2007) in Educational Technology Magazine. Clark argues that serious games have little to offer that improves upon traditional methods such as lectures. He continues to invoke his 'vehicle' analogy which describes the medium as simply the vehicle of delivery for instruction - something that is not really a part of the instruction itself. What Clark fails to acknowledge is that this analogy doesn't work with games [17]).

Viewing games as receptacles for content rather than teaching methods does work in a select subset of games (puzzles, game show styles, etc.) but this represents a very small portion of the ways in which games can be and have been used to facilitate learning. The design of a digital game is a complex process, as is the design of instruction – one cannot simply be imposed onto the other, and the success of an educational game can only come from a successful synergy of both. Thus, if an educational game is a success or failure, the credit (or blame) cannot be attributed to either the game (design) OR the instructional design, but must be placed squarely on the shoulders of both. The medium of the videogame isn't just a vehicle, like a car that gets us from one place to another. Even if we *did* want to stay with the vehicle analogy, a closer approximation might be to use land vehicles, planes, ships, and submarines rather than just trucks. True, they do all get us from one place to another [18], and much as I like nice cars, I wouldn't want to have a Ferrari when what I really need is a submarine.

Further, it is interesting that Clark chose to reference this older edition of Gredler's chapter (1996) when a newer one is available (2004). In 1996 there was no http://www.xbox.com/en-US/XBox, no Gamecube, no Playstation II. In fact, the

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[17] nor with a great many other technologies - especially those that are interactive in some way

Playstation I had been released only two years earlier and almost certainly played no role in Gredler's work. There were no console games, no cell phone or mobile games, and no technologies that a modern developer would recognize. In other words, the "technology" of Educational Technology was vastly different and discussing the effectiveness of media, potential or otherwise in 2007 using reports from more than ten years ago is like discussing today's traffic issues using data from 1820.

The truth of the matter is that technology, in and of itself, neither improves or impoverishes instruction, and "instructional technology only works for some kids, with some topics, and under some conditions – but that is true of all pedagogy. "There is nothing that works for every purpose, for every learner, and all the time." (Mann, 2001, p. 241)

Analytical Approaches to Games for Learning

Who is studying commercial games in educational contexts?

The use of commercial games in educational contexts is still an understudied area, due at least in part to the difficulty of finding willing participants. Very few studies have produced any quantitative data that could be used to compare against more traditional forms of teaching. By far the majority of studies have been qualitative, ethnographic case studies. The following paragraph highlights a few of these.

Sandford et al conducted a year long study using three COTS games: *The Sims 2*, *RollerCoaster Tycoon 3*, and *Knights of Honor* and found that teacher familiarity with the game was important, but not as important as familiarity with the curriculum and general

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[18] much like successful instruction does

teaching competence (Sandford, Ulicsak, Facer, & Rudd, 2006). One possible inference that can be drawn from this study, which supports findings from other studies regarding the need for active teacher involvement in the process is that while commercial games can enhance classroom experiences with learning, they cannot compensate for lack of knowledge or skill on the part of the teacher. Kurt Squire devoted his doctoral dissertation to a study of *Civilization III* in high school history, and among his conclusions were that even though the game may not have provided measurable learning when it came to historical facts, it did seem to help students learn *about* historical contexts and that historical choices (such as building a village by a river) influence outcomes (Squire, 2003). In his study, Squire also found that players make up recognizable 'types', who take up the game for various reasons: achievers, explorers, socializers, game killers (Bartle, 1996), and that a key motivating factor had to do with elements often overlooked by educators: humour, style, and aesthetics (Squire, 2003). Simon Egenfeldt-Nielsen also conducted a classroom study as part of his doctoral work. He used the game *Europa Universalis II* in a Danish school to teach history over an eight week period. All found that the games they used could motivate and foster information-handling and problem-solving skills, but they also highlight the constraints that occur as a result of the technical demands of the game.

James Paul Gee has written extensively about the learning value of commercial games and the type of pedagogy they promote but has not conducted studies on their use in educational settings.

In the next chapter, I will report on several analyses that draw connections between commercial games and known pedagogy.

Finally

"This interest in games is encouraging, but most educational games to date have been produced in the absence of any coherent theory of learning or underlying body of research. We need to ask and answer important questions about this relatively new medium. We need to understand how the conventions of good commercial games create compelling virtual worlds." (Shaffer, Squire, Halverson, & Gee, 2004)

While there are many involved in studying games for the purposes of education, the medium is far too new and the discipline too young to become complacent and accept the existing approaches as sufficient. We will need far more theories and models, if for no other reason that to help us understand games; in other words we will need to broaden the field before we can start to look at narrowing the field. The following chapter will describe a radically new approach to the analysis of games, which can be applied to software in general and uses a user's, though not really a user-centered perspective to the problem of design. It is referred to as Instructional Ethology.

CHAPTER 4. GOOD GAMES = GOOD PEDAGOGY: STUDYING THE

MASTERS

> When asked how he developed his mathematical abilities so rapidly, he replied "by studying the masters, not their pupils."[19] - *Niels H. Abel (1802 - 1829)*
>
> Teaching should aim at disengaging and strengthening the pupil's individuality; at teaching him how, by studying the masters, he must learn not to ape them, but to study himself, as they have done. *Maurice Ravel (1875 - 1937)* (source: Calvocoressi, 1913, p787)

Note: Parts of this chapter have been previously published (Becker, 2006d, Becker, 2008).
Parts of section 1 & 2 were previously published as:
Katrin Becker, **Pedagogy in Commercial Video Games**, Book Chapter , in Games and Simulations in Online Learning: Research and Development Frameworks, Information Science Publishing edited by David Gibson, Clark Aldrich and Marc Prensky 2006 (Ch. 2 p.21-47) http://www.igi-pub.com/ *"This chapter appears in Games and Simulations in Online Learning: Research and Development Frameworks edited by avid Gibson, Clark Aldrich and Marc Prensky Copyright 2006, IGI Global, www.igi-pub.com. Posted by permission of the publisher."*
–and–
Parts of the section 3 are being published as:
Katrin Becker, **Video Game Pedagogy: Good Games = Good Pedagogy**, Book Chapter (CH. 7), in Games: Their Purpose and Potential in Education edited by Christopher T. Miller, 2008, Springer *"The right to publish material from this chapter as part of her thesis are retained by the author."*

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[19] At the age of 16, Abel gave a proof of the binomial theorem valid for all numbers, extending Euler's result which had only held for rationals. At age 19, he showed there is no general algebraic solution for the roots of a quintic equation, or any general polynomial equation of degree greater than four, in terms of explicit algebraic operations. To do this, he invented (independently of Galois) an extremely important branch of mathematics known as group theory, which is invaluable not only in many areas of mathematics, but for much of physics as well. Among his other accomplishments, Abel wrote a monumental work on elliptic functions which, however, was not discovered until after his death. source: http://mathworld.wolfram.com

Why Study the Masters

This chapter sets out to explore the assumption that 'good' games embody 'good' pedagogy.

Each form of media has, in its turn, been applied to educative goals. Each also has, to a greater or lesser extent, been studied as a medium for the delivery of instruction, and each has left us with a better understanding of how we might approach a new medium if our primary goal is to educate. Games are a medium of communication and expression (Bogost, 2007) and possess some parallels with other forms of media. Most have also gone through a period of societal resistance until they became accepted. As Henry Jenkins points out (as in Palmer, 2004), the early days of film were little more than chases and pies in the face, yet just a few years later we see the likes of Chaplin's *The Tramp* [1915], and Griffith's *Birth of a Nation* [1915]. Thirty years after the beginning of film we already had recognized works of artistic merit, popular appeal, and lasting significance, such as *Tarzan of the Apes* [1918], *Nanook of the North* [1922], *The Jazz Singer* [1927], and *Steamboat Willie* [1928]. Film also has 'stars', such as Charlie Chaplin, Rudolph Valentino, Mary Pickford, and Douglas Fairbanks. Radio and television may have started with somewhat more somber offerings insofar as their early shows were somewhat less extreme, but they too had both classics and stars within a few years of their introduction, as well as a broad range of offerings in several genres, both fictional and not.

Is it so radical to suggest that early gems of the game industry might already be out there, and we just aren't recognizing them? The average age of video game players in 2006 was 33 (ESA, 2006), so we can't really classify videogames as children's toys.

Actually, gamers already recognize game 'classics', such as *Pong* [1972], *Donkey Kong* [1983], *Tetris* [1988], *Monkey Island* [1990], and others. There are also 'stars': some, such as Mario, Lara Croft, and Link from Zelda belong to a category that would include Mickey Mouse, while others such as Will Wright, and Peter Molyneux are more tangible. Although each medium has its own unique qualities, each also shares qualities with the others, making it possible to compare as well as contrast. When we examine media such as radio, film, television, and even popular music, we see some similarities in the ways they have been accepted into society and the objections and resistances that were raised along the way (Williams, 2005a).

Even though many offerings from literature, in film, on radio, and in television are designed primarily to entertain, there are also many that are intended to persuade - to *teach* us something - and that intent lies at the very heart of instructional design. When looking at how the different forms of modern media have been used this way and which particular instances have been chosen, one notion stands out - many of the most remarkable and effective 'lessons' taught to us this way have been created by extraordinarily talented writers, directors, and/or producers together with their teams[20]. They have, by and large, not been created by professional educators or instructional designers. Though they may lack the forms we have come to expect from educational media and other objects, we should recognize the opportunities afforded us in studying these outstanding examples, and try to learn why they have the impact they do. Why do many of Spielberg's movies move us so? Why did the radio show *Amos 'n' Andy*'s enjoy

such lasting popularity? Why have many people learned more about American politics and government from the television show *The West Wing* [1999] than they ever did in school (Beavers, 2002)? While we're on the subject of the appropriation of media objects for the purposes of education, it might be enlightening to note that the same can be said of literature. It is unlikely that Charles Dickens, Harper Lee or Miguel De Cervantes had the classroom in mind when they wrote *A Christmas Carol*, *To Kill a Mockingbird*, or *Don Quixote*. They had a moral or two in mind when they produced these works to be sure, but none were teachers or instructional designers. Still, there is much we can learn from them, not only from the lessons they were teaching, but also from how those messages were crafted.

When we turn our attention to computer and video games, the puzzle climbs to a whole new plane. Not only can we ask what makes this medium's finest examples so compelling, but, what could possibly motivate an individual to log thousands of hours in a game that, when reflected upon, doesn't appear to offer more of a reward than time spent? After watching players for a time, it becomes obvious that it is not done just for the fun. In fact, games can be excruciatingly frustrating (Johnson, 2005). Clearly there is something else at work beyond pleasure or entertainment. Could it possibly be that at least some of these games fulfill a fundamental human need to learn or to be challenged? While there are exceptions (such as *Tetris* or *Electroplankton*), modern videogames are often extremely complex, requiring many hours to learn how to play. Somehow, these games manage to hold the players' attention while they fumble through the 'learning

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[20] Such as: Steinbeck's *The Grapes of Wrath* (1939), Orwell's *1984* (1954), Golding's *Lord of the Flies*

curve', and then continue to motivate them as they approach expertise. All in the same game. Sometimes for millions of players. How?

Games are so engaging precisely because they tap into some of the most effective approaches for learning. Perhaps successful games teach us to play in the manner we learn best. If this is true, it should be possible to find evidence to support this hypothesis. One way to find this evidence is to explore the connection between the design of existing commercial games with accepted pedagogy.

It is important to establish the pedagogy of games because the last time we tried to use digital games in education during the 'edutainent era' it didn't go so well and a part of that reason was that we did not understand the medium of the digital game (Egenfeldt-Nielsen, 2005). Games are far too complex to create to end up having them ignored because the target audience finds them tedious, boring, too difficult or too easy. To hear the kids talk, we already have enough learning objects like that. We probably don't need any more. What readers can take away from this chapter is evidence that good games already implement sound pedagogy, *and on some level*, this implementation of sound pedagogy is in fact a major contributor to what makes it a successful game. It is comforting to know that the implementation of sound pedagogy can lead to a compelling game - this may mean that this is also true of other learning technologies. That's not to say that educational games should strive to become commercially successful like their pure entertainment cousins - very few educational objects receive great commercial success. In education, we are working with an entirely different scale than the video game

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(1955), Spielberg's *Schindler's List* (1994)

industry at large. As I have argued elsewhere (Parker, Becker, & Sawyer, 2008), commercial games can have production budgets of tens of millions of dollars, while most educational games rarely cost more than tens of thousands and often cost less. They make games that have development teams numbering in the dozens and budgets in the millions of dollars. They also expect profit in the millions. On the other hand commercial success and educational efficacy are not necessarily mutually exclusive.

With a bit of effort, it is possible to find examples of computer and videogames that embody virtually every well-known learning theory in existence. Whether the 'instructional design' was intentional or not, game designers have had to figure out how to keep their audiences interested and motivated while they learn the games - and judging by the number of people who willingly pay money for the experience, they appear to have been successful. This chapter examines several commercially successful games using instructional design theories and models as a framework for analysis. The implications of such an examination are two-fold:

1. Games work as instructional technology. Thus, established learning and instructional theory can be connected with current design practices in this new medium. Since claims are being made that digital games should be viewed as viable technology for use in education, this forms one facet of the necessary proof of concept.

2. Instructional Design works for games. We can verify that games designed along learning and instructional theory lines can and do result in artifacts that remain compelling as games. This does not mean that ID methods can be followed like recipes to produce successful games. We have not yet discovered a formula for generating blockbuster movies or classic literature either, but we still value formal

training in film-making and in writing. It helps develop better writers, play writes, and film makers.

Games and Learning Styles (Connecting the Dots, Generally)

It is generally accepted that different learning styles exist, although articulating what those differences are, the nature of their effect, how to identify them and how best to address them educationally remain areas of active research and debate. However, several viewpoints seem to be shared by all. First, people tend to learn more effectively, and are generally more satisfied when their personal learning styles are taken into account in the design of instruction. Second, if we *only* cater to an individual's strengths by presenting everything in their favorite style then we are doing them a disservice by not encouraging them to develop their other skills. Finally, while most teachers also have definite preferences for teaching styles, most can learn to adopt others, given adequate support. The potential exists to address all three of the previous viewpoints through the use of games for learning, that is, supporting preferred learning styles, encouraging development of other styles, and support for various teaching styles.

Whether or not what is learned through games is valuable will not be debated here, but it cannot be denied that a great deal of learning does happen in games (Gee, 2003). Although most games favour visual approaches to the presentation of information, computer games that are considered 'good' (i.e. popular and highly rated) provide information in various formats. By providing information in multiple formats (visual, textual, auditory, etc.), players cannot only choose a style that matches their own preference, they can also practice their skills in others. Games may not do much for helping teachers to develop other teaching styles (unless the teacher is an active

participant in the game activity), but they can be used to provide alternatives that the teacher may not be comfortable providing on his or her own.

The ultimate goal for the makers of any commercial game is, of course, profit. If the gameplay is not appropriate to the audience, the game will not sell. Since the targeted audiences invariably include individuals with various learning styles, it follows that to be successful the gameplay must address these learning styles, deliberately or not. Modern games are very expensive to produce, so an adequate return on investment is essential. Many games have a fairly steep learning curve, and so they must be well-designed to support players while they learn the game, yet once the player is acclimatized, the gameplay must change. Missing the mark in either case results in a game that that doesn't sell. Inadequate support while learning the game discourages novices, while too much 'support' during gameplay is obnoxious to experienced players.

Designers address different levels of skill in a number of ways, which are often employed simultaneously in the game. For beginners, they exploit many different learning approaches and forms of feedback that keep people engaged and help them learn the game. A player who remains in one area too long may be offered a hint about a direction they might try, or one who is supposed to be searching for a particular item may be given more information about how to obtain that item. These hints sometimes come in the form of images, sometimes text, narrative or just sounds. Rarely do games simply give the player the 'answer'. As players become better at using the game, the amount of support offered automatically is reduced, by monitoring the players' actions in ways very similar to what educators call assessment, and responding appropriately. As the players' skills increase, so do the challenges. Players are also often given direct control over the

amount of support they receive and can choose among various modes (beginner, expert, etc.).

Some learning styles do seem to be better supported in some games than others (many games are highly visual, though text and numbers are also often significant), and this has implications for how children who play games are 'learning to learn'. Given the strong and still growing popularity of games in the developed world, this 'training' often begins before they even start school, and continues all through school and beyond. Whether this will be found to influence learning styles in individuals, and to what extent, remains to be discovered. As Marc Prensky says, any time people spend that much time doing something, it is bound to have an affect on their brains (2001b, 2001c). There are indications that playing games also has an effect on how they learn and work once they get older (Beck & Wade, 2004), so early indications are that at least some aspects of an individual's learning style may be affected through gameplay.

Five well-known learning styles models were chosen for analysis. They include Gardner's Theory of Multiple Intelligences, the Keirsey Temperament Sorter, the Gregorc Style Delineator, Felder's Index of Learning Styles, and Kolb's Learning Style Inventory. Each model is summarized, followed by a brief analysis of how games address the key points raised.

Keirsey (Myers-Briggs)

The Keirsey temperament sorter is based on the Jungian model developed by Isabel Briggs Myers and her mother (Myers & McCaulley, 1985). It uses four different scales, which are used to classify personalities into four different basic types:

1. **Artisans** value freedom and spontaneity. They tend to be impulsive, playful and creative.

2. **Guardians** value belonging to a group or community. They tend to be traditional, responsible and conservative.

3. **Idealists** value personal growth, authenticity, and integrity. They tend to try and encourage these traits in others. This group includes people they define as 'teachers'.

4. **Rationals** value competence and intelligence. They strive for knowledge, predictability, and control. (Keirsey & Bates, 1984)

Each type is defined by the result of a test, which categorizes traits into one each of four preferences. The results allow for sixteen possible combinations: four for each personality type.

Table 4.1 Keirsey Temperament Scales	
E = Expressive (extrovert)	I = Reserved (introvert)
S = Observant (sensation)	N = Introspective (intuition)
T = Tough-Minded (thinking)	F = Friendly (feeling)
J = Scheduling (judgment)	P = Probing (perception)

Although in truth, the degree of choice permitted in games is largely an illusion, the appearance of virtually unlimited choice exists. As a consequence, artisans get their freedom, and through the non-linear (sequential) possibilities built into most games, their need for spontaneity is met. Additionally, there is usually a relatively 'linear' path through the game that can be taken, which will appeal to the guardians and rationals, but the choice remains with the player. Many games cannot be won without some form of cooperative efforts, either with other players (as in most MMOGs , and some multiplayer console games), or with the non-playable characters (NPC) that are part of the game. A

game like *Pikmin 2* requires the player to enlist the help of dozens of tiny 'Pikmin' as they are essential for everything from picking up objects to defense from attack.

Aspects of personal growth, authenticity, and integrity are inherent in many games too. Transgressions, and playing the 'bad guy' are permitted, but many games implement character attributes such as 'health' and 'wisdom' which are often diminished as a direct result of these actions. Many games, from violent games like *XIII*, where players take on the role of an assassin with amnesia, to games like Peter Molyneux's *Black and White* or *Fable*, where even the appearance of your avatar is affected by your choices have elements that relate to the authenticity of the roles adopted by players. In addition, 'personal growth' in the form of the evolution of the player's avatar as skills are acquired and accomplishments achieved is one of the hallmarks of modern gaming. This too appeals to the idealist in us.

One of the key aspects of successful games is how well they balance between randomness and predictability - a game that is too predictable quickly becomes boring, yet one that is too unpredictable appears random, and players do not feel in control. Most games allow users to adjust the degree of randomness, and so stout rationals can reduce the element of chance, while artisans can 'dial it up'.

Kolb's Learning Styles

David A. Kolb (with Roger Fry) included four elements in his model: concrete experience, observation and reflection, the formation of abstract concepts and testing in new situations. (Kolb & Fry, 1975) These four elements form the nodes of a connected circle of experiential learning, with learners able to begin at any point along the circle. Ideally, learners will posses balanced abilities in each of the four areas, but in reality,

they tend to polarize towards one of four 'poles'. These four poles are summarized in the table below.

Table 4.2 Kolb Learning Styles	
Learning style & Characteristic	Description
Converger: Abstract conceptualization (AC) + active experimentation (AE)	- Practical application of ideas - Focus on hypo-deductive reasoning on specific problems - Unemotional - Narrow interests
Diverger : Concrete experience (CX) + reflective observation(RO)	- Imaginative ability - Generates ideas and sees things from different perspectives - Interested in people - Broad cultural interests
Assimilator : Abstract conceptualization (AC) + reflective observation (RO)	- Can create theoretical models - Excels in inductive reasoning - Abstract concepts rather than people.
Accommodator : Concrete experience (CX) + active experimentation (AE)	- Doing - Risk taker - Can react to immediate circumstances - Solves problems intuitively

Kolb & Fry claim that once an individual's style is identified, instruction can be organized to support his or her strengths to give confidence, while still encouraging the further development of the others.

In games, the converger can choose to remain unemotional and detached, yet imaginative exploration is encouraged and rewarded. Theoretical models can be devised and tested with minimal risk, yet risks can be taken, and normally the worst that will happen is that the player must start over. A key aspect of good games is that the player can take up the game in many different ways: as a neutral orchestrator, or as an

impassioned participant. Games encourage accommodator abilities of immediate reaction to circumstances and converger abilities of the application of ideas, both within the bounds of the 'magic circle' of play (Huizinga, 1950) because the usual rules and consequences of reality don't apply. Divergers can identify with other players or NPCs (non-playable characters) as though they are people, and assimilators can relate to them using whatever conceptual frameworks they like. Some will lead to greater success within the game than others, but the fact remains, that it is only a game - exploration and experimentation are actively supported in most good games.

Gregorc

Based on left / right brain studies, Gregorc's system of learning takes into account different ways of perceiving and ordering information. Perceptual preferences can be described as abstract, which involves reason, intuition, and deduction, or concrete, which involves the senses. The ordering preferences indicate how individuals are most comfortable organizing the information they incorporate. The two ends of the spectrum here are sequential (or linear and systematic), or random (less organized). (Gregorc, 1985)

Table 4.3 Gregorc's Learning Styles	
Concrete-Sequential	- Linear and sequential.
Concrete-Random	- Concrete and intuitive - Thrives on problem-solving.
Abstract-Sequential	- Abstract and analytical - Thrives on a mentally challenging but ordered learning environment.
Abstract-Random	- Emotional and imaginative, - Prefers an active, interesting, and informal learning environment.

By design, good games support the approaches of concrete learners through a myriad of feedback mechanisms: visual, auditory, textual, progress charts, etc. while abstract learners can ignore which ever feedback mechanisms they choose - often by simply switching them off. Abstract learners can develop theories and test them out within games in ways not feasible in real life. The 'reset' button remains available to both whenever they get into trouble, and multiple lives provide endless experimentation.

Sequential learners can progress through games in an orderly fashion, they can strategize about which tasks to complete first when there are choices, and follow through. But most games also permit a fairly ordered progression through the challenges, yet for more random learners, the option also exists to choose among various 'next steps'. Although some games require certain tasks to be completed in certain orders (good for sequential learners), most also allow for a substantial degree of freedom for random progressions.

ILS (Index of Learning Styles)

Felder's model is based on the assumption that students will learn better if material is presented in a manner that best matches their style, so for each learning style, there is also a teaching style to match. (Felder & Silverman, 1988) The original model has been altered in recent years to exclude the original aspect of inductive/deductive style as the authors have come to believe that the 'best' method of teaching is inductive regardless of which style the learner prefers. (Felder, 2002)

Table 4.4 Index of Learning Styles	
Active (Doing)	Reflective (Thinking)
Sensing (Facts, processes)	Intuitive (Concepts, relationships)

Visual (Seeing, picturing)	Verbal (hearing, reading, saying)
Sequential (Step-wise)	Global (Leaps, random)

When it comes to Felder's learning styles index, the only aspect that is not well

supported within most games is that of reflection, although it can often be found to be

thoroughly supported through the communities of players that can evolve outside of the

game (Galarneau, 2005). One of the qualities of games that makes them both distinct

from other technologies that have come before and intrinsically suited to experiential

approaches to learning, is that they are highly interactive. ALL games require players to

'do'. Most modern games are highly visual in presentation, and yet they almost always

include narratives and text to either augment visual information, or provide extra

information not available in other forms. They require players to learn facts and

understand processes, but they also require them to understand concepts and synthesize

relationships. Most games have sequential aspects, which are balanced by global

requirements.

Gardner's Theory of Multiple Intelligences

According to some, Gardner's Theory of Multiple Intelligences is one of the most

significant developments in learning theories to come out of the last quarter of the 20th

century. The foundation of this theory is that we all employ different strategies for

learning, and that these strategies relate to internal strengths and capabilities that can be

classified into eight categories, which Gardner called 'intelligences' (Armstrong, 2000).

Gardner proposes at least eight primary forms of intelligence: (1) linguistic, (2) musical,

(3) logical-mathematical, (4) spatial, (5) body-kinesthetic, (6) intrapersonal (e.g., insight,

metacognition), (7) interpersonal (e.g., social skills), and (8) naturalistic (sensitivity to

natural phenomena, and classification skills). The implication of this theory is that learning can become more effective if we recognize and develop instruction for these intelligences. Generally speaking, learning & assessment should include more than one 'intelligence', as each is more than simply a content domain; it is also a learning modality. Cultural differences play a key role, as each culture tends to value and emphasize particular intelligences in favour of others.

Connecting Gardner's ideas with the design of games is particularly effortless, as almost every one is evident in almost every successful game - in fact, it could be argued that one of the features of games that make them so engaging is that they address each one of these forms, providing game players with a particularly rich experience, where each player has an opportunity to take advantage of her own particular strengths. By contrast, traditional (i.e. content-driven) formal education tends to concentrate primarily on just a few: linguistic, logical-mathematical, and to some extent interpersonal.

1. **Linguistic**: Linguistic intelligence coincides nicely with Gagné's Verbal Information category, and thus what was said there also applies here. Games often include written and spoken elements - for game play, as well as for direction and help. (Rosas, Nussbaum, Cumsille et al, 2003)

2. **Musical**: Virtually all games include sound to enhance play - there are sound-effects, both diegetic and non-diegetic, as well as music to set the mood or provide feedback about game states. In some cases musical scores for games are as sophisticated as they are for film. Sounds are used as feedback and reinforcement as well as for effect and enjoyment.

3. **Logical-mathematical**: Strategy is one of the key elements in play - the extent to which this intelligence is exercised depends heavily on the genre and specific game played. Puzzle games rely heavily on logical and mathematical intelligences

to win. The management type games, like *Zoo Tycoon* also involve reliance on and further development of this intelligence, for it is virtually impossible to manage the zoo well without an ability to plan and manipulate a fairly complex set of resources. Simpler games, such as *Pikmin*, still requires counting and arithmetic. Moving an object often requires a minimum number of Pikmin, and even very young players quickly learn to do simple calculations in order to get the optimal number of Pikmin into position to complete a task.

4. **Spatial**: Games are of course highly visual, providing a rich and colourful 2- or 3-dimensional environment, which is always at least partially under the player's control in terms of what is visible. It is quite common, for example, to be shown multiple simultaneous first- and third-person views - which not only tap into one's spatial intelligence, but at the same time actively help players learn to use these views in their gameplay.

5. **Kinesthetic**: Although games can not yet place their players physically in the game, most games do require players to 'place themselves' virtually in the game in one way or another and all involve movement and action which, at the very least, is realized through physical movements of the players hands (watching players quickly confirms that there is indeed more going on than just hand motions). There are, of course, numerous games that are specifically designed to involve mild to heavy physical activity, such as *Dance Dance Revolution*, and, to a lesser extent, games like *Donkey Konga* as well as the kinesthetic involvement that has quickly become a hallmark of Wii games. In spite of the fact that these games are marketed on their 'Kinesthetic Intelligence' attraction, they still provide musical, visual, and linguistic stimulation, as well as requirements for logical thinking and strategizing.

6. **Intrapersonal**: Strategy is one of the key elements in play - once again this is a key element in games: they force players to discover and practice what one can do, what one wants to do, how one reacts to things, which things to avoid, and

which things to gravitate toward. Many games present scenarios that involve
ethical dilemmas, and have moral (or immoral) themes.

7. **Interpersonal**: Many of the most popular games include multi-player modes,
many online games massively so. Even single player games typically include
multiple NPC's (non-playable characters) and often require varying degrees of
both competition and cooperation in order to win.

8. **Naturalistic**: Games with naturalistic themes are common - whether they include
purely realistic flora and fauna, purely fantastical ones or some combination of
the two. Clearly, games like *Zoo Tycoon* call upon one's natural intelligence in
order to be able to identify various animals' requirements for housing and care.
Beyond that, any game that creates a world with geography and a variety of
inhabitants require classification, as well as naturalistic skills and understandings.
Once again, even a game like *Pikmin* includes several distinct kinds (species?) of
Pikmin, each with its own strengths and weaknesses.

Although not all games embody every kind of intelligence, most can be observed
to embody a majority of them, and it is always possible to find a specific game that
favours one or another. Given that commercial games are designed in the hopes of
appealing to the widest possible audience, this should not be surprising.

From the General to the Specific

The preceding section introduces a framework for analysing game design to show
that games embody recognizable theories of learning styles. In *Pedagogy in Commercial
Video Games* (Becker, 2006d), the author has also used the same technique to examine
how several learning and instructional design theories are embodied in games. It is not
especially difficult to cherry pick specific elements from a wide variety of games in order
to build evidence for the pedagogy of games, and while this may be a useful approach, it

also has its limitations. It is useful as a means of starting to build support for the main assumption of this chapter, namely that 'good' games embody 'good' pedagogy.

Suppose for example we are going to examine Gagné's Nine Events of Instruction (Gagné, 1985). If we show that nine different games each implement one aspect well, we have still not shown that any one game is capable of embodying Gagné's theory. Further we have no evidence that ANY game that was able to incorporate all nine events would still be a popular game. We all remember films for example that may have had one or two good moments but are otherwise unremarkable or even bad. It is a much more significant feat to look at the whole of a work and see how the various parts fit together. The next section explores this notion further.

Connecting the Dots, Specifically

The following section describes the results of a detailed analysis of three well-known commercial games as seen through the lens of six pedagogical models: Gagné's Nine Events of Instruction, Reigeluth's Elaboration Theory, Merrill's First Principles of Instruction, Activity Theory, Jonassen's Constructivist Learning Environment, and Problem-Based Learning.

The Games

<u>Phoenix Wright, Ace Attorney</u>

Figure 4.1 Phoenix Wright
(source: <u>IGN.com</u>)

<u>*Phoenix Wright: Ace Attorney*</u> has received consistently high ratings though it is a relatively new title. Its format is different from most popular games today and that design makes it of interest for study. For one thing, it is surprising to many that a game featuring a lawyer as the main character should become so popular. Another is that this game is essentially a branching story that ultimately has only a single path to the end. This is a format that is potentially quite useful in education - gameplay is essentially 'on rails' with few opportunities for exploration outside of the main goals and yet this game remains very highly rated. Many of the criticisms of this game have to do with the low replay value afforded by the format, but while players expect to be able to play commercial games more than once, a lack of replay-ability may not be a detractor in an educational context - learners in a classroom situation may never have an opportunity to play the game again after they have completed it once. Another aspect of interest to educational game design is that it has very minimal animation so a game such as this could potentially be produced on a fairly low budget. This game is currently only available for the Nintendo DS portable platform.

In this game we play the role of Phoenix Wright, a newly-minted defense lawyer taking on his first cases. The game consists of five separate cases each involving a murder investigation that culminates in a trial which we must win. Each of the main

characters has interconnecting back stories, bits of which are revealed from time to time through the five cases. In all cases the person accused of the crime is innocent and it is our job to gather evidence and other clues which will be used to argue our case during the trial in order to have our client found not guilty. We must also discover who the real killer is. It should be noted that although it is possible to learn some of the terminology associated with the legal system through playing this game, the game's designers make no claim as to the accuracy of the court procedures or any other legal aspect of the game.

Animal Crossing, Wild World
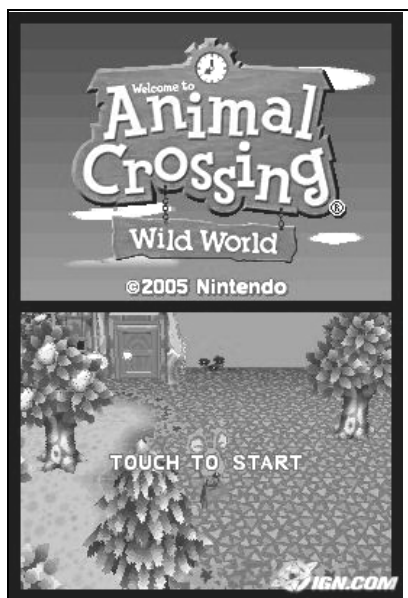
Figure 4.2
Animal Crossing Wild World
(source: IGN.com)

Animal Crossing: Wild World (ACWW) is an open-ended RPG (role-playing game). The original version of the game, *Animal Crossing* appeals to a wide range of ages both male and female and is on many Best Games lists. *Animal Crossing: Wild World* was released for the DS console, but is essentially the same as the original *Animal Crossing*, with respect to the main story, controls, interface, and how it teaches players what they need to know. Ultimately *ACWW* was chosen for study over the original version for the convenience afforded by the small portable device as opposed to the standard console which must be connected to a television.

This game is situated in a small fictional village whose landscape includes trees, flowers, rocks, an ocean front, and a river with several ponds and waterfalls. Players may choose the name and gender of their character (avatar) as well as the name of the town in

which the game takes place. The town has various locations where things can happen: a general store, a town hall, a clothing shop, a museum, and a main gate, most of which serve multiple purposes. Although gameplay is the same, there are some differences between the console and the DS version. For example in the console version there is also a town dump whereas the DS version has a recycling bin inside the town hall. These are functionally equivalent as they behave much the same way and serve the same purpose. There are other townspeople besides the player which include various permanent residents as well as residents that move in and out from time to time. Curiously, the characters in this game take their houses with them when they leave! There are no required tasks or goals to achieve and no definitive end to the game; instead players decide for themselves which goals they want to pursue. When the game first begins, the player is provided with a small house that has a small mortgage held by the owner of the general store. The local currency is called the 'bell'. Virtually all role-playing games and many other games have some sort of in game economy and this one is no different. Players can earn bells in various ways and can then use that money to pay off the mortgage, which is held by the shopkeeper. Each time a mortgage is paid off, the player gets a new addition to her house along with a new, larger mortgage. Although players have no choice about the additions to their house, they can decide not to pay off the mortgage and pursue other goals instead, and they are not penalized for choosing this path. Other goals include various collections (fish, insects, fossils, pictures, clothing, furniture, and a few other items), cultivating flowers, growing trees, designing star constellations, or cultivating friendships among the residents. *Animal Crossing* is a game

space where players are rewarded for tending (flowers, orchards, friends, etc.) and for collecting (fish, bugs, furniture, etc.).

The New Super Mario Bros.

Figure 4.3 The New Super Mario Bros. (source: IGN.com)

The New Super Mario Bros. is a platform game whose original version is more than 20 years old which still appears on many top 100 lists. The particular version used for study is a remake of the original *Super Mario Bros.* Mario is a game for which any claims to educational value could only be made by either: 1) a profound exaggeration of the

content of the game or 2) a radical expansion of the definition of education. Nonetheless, this game is still of interest in the current context for a number of reasons. First, it has remained consistently popular throughout its various incantations since it was first released over 20 years ago and that kind of staying power deserves further examination. Secondly it bears a strong similarity of form to one of the most popular educational games for that same time period, namely *MathBlaster* and while *Super Mario Bros.* continues to garner praise from game designers and gamers alike, *MathBlaster* is in many ways its antithesis (Becker 2006a). Why is one so popular with almost everyone while the other is popular among teachers but panned by everyone else? A closer examination of Super Mario Bros. and its sequels may reveal some clues.

This game has a very simple premise, Bowser and Bowser Jr., the bad guys, have kidnapped Princess Peach, and it falls to Mario to rescue her. Virtually all of the *Mario*

games are two-dimensional platform games where Mario can move from side to side and sometimes up and down but all movements and action occur in a flat, two-dimensional space. The nature of the game's challenges could perhaps best be described as those of an obstacle course. There is an obvious beginning to each course, obstacles (environmental and other characters and objects) to be avoided or neutralized (no-one dies in this game) and an end goal to reach, all within a pre-determined time period. As in a real life obstacle course, the obstacles themselves may have no logical connection to the ultimate goal - they are merely things that are trying to prevent us from reaching the end. *The New Super Mario Bros.* contains 80 different courses (levels) spread across eight different 'worlds', where the set of courses in one world share similar landscapes and challenges. When the game begins, we see Bowser run off with Princess Peach, but then we do not see her again until we reach the end of the courses in the first world.

Gagné's Nine Events of Instruction as expressed in Phoenix Wright

Figure 4.4 Phoenix Wright
image source: IGN.com

The work of Robert Mills Gagné (1916-2002) is well-known in the educational technology discipline and along with Bloom's Taxonomy (Bloom, 1964) is often seen as standard for instructional design in North America. Gagné's Nine Events of instruction (Gagné, Briggs, & Wager, 1992) still functions as a useful guide for the general design of instruction. Game elements can directly and indirectly embody all elements of this model, as is indicated in the image below. Connecting game elements to instructional design model components serves to

Figure 4.5 Gagné's Nine Events embodied by Game Elements

source: K.Becker (see Appendix 2 for a description of Game Elements)
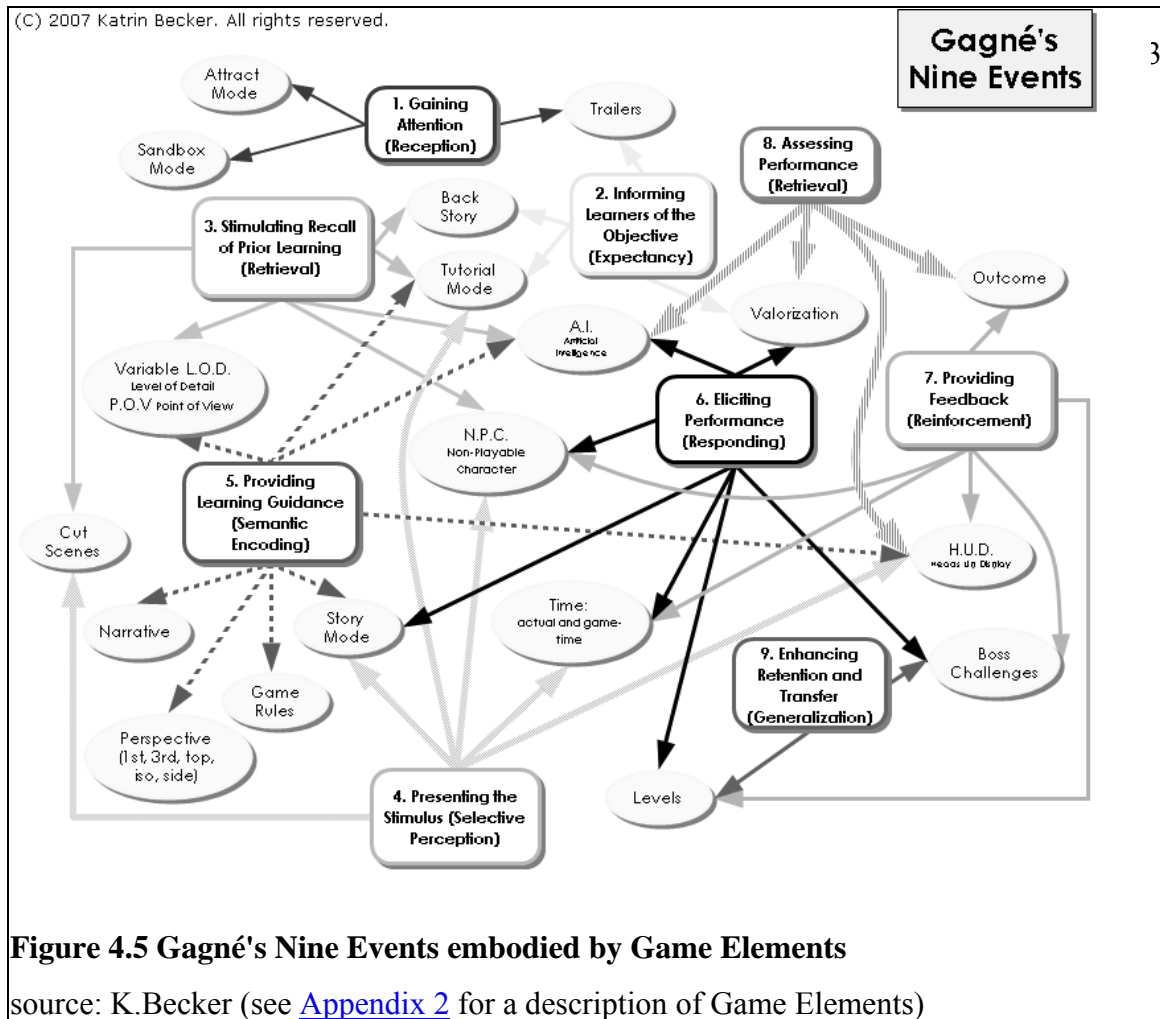
illustrate which game elements can be shown to implement accepted instructional

approaches (Becker, 2006d) as described in the first section of this chapter and the

second section takes a more detailed look at Gagné's nine events and how one specific

game fits.

Gagné's theory stipulates that there are several different types or levels of

learning, implying that each type also requires a different approach to instruction. Good

games already do this. Game designers employ multiple approaches to both aid and

challenge players. According to Gagné, 'an instructional plan can generate both

appropriate environmental stimuli and instructional interactions, and thereby bringing

about change in the cognitive structures and operations of the learner' (Anglin, 1995).

Gagné's 'Nine Events of Instruction' ([Gagné, 1985](#); [Gagné, Briggs, & Wager, 1992](#)) are purported to provide the necessary conditions for learning, and also for the appropriate selection of media. As will be explained, (good) games meet virtually all the criteria listed. As in all good instruction, the nine events need not be distinct, separately identifiable tasks as often elements of one 'event' can be combined or intertwined with another. This also holds true for other well-accepted instructional design models, such as goal-based learning ([Schank, Kass, & Riesbeck, 1994](#)) and story-telling ([Brown, Denning, Groh, & Prusak, 2001](#); [Schank, 1990](#)). For example, gaining attention, explaining the objective and stimulating recall are often all combined as part of the initial 'set-up', and creates the narrative used in all three forms.

The following section examines Gagné's Nine Events of Instruction ([Gagné, Briggs, & Wager, 1992](#)) through the lens of a single game: *Phoenix Wright, Ace Attorney*.

1. Gaining Attention: Reception

Capture their attention. The process of gaining attention in games often begins long before the game is even released. Trailers and demos are important for providing advance knowledge of many aspects of a game including the style, back story and main objectives. Just like movie trailers are designed to entice people to watch the film in the theater, game trailers are designed to entice people to buy. However, game advertisement as well as game reviews have only limited influence over game sales - word of mouth plays a significant role and for that the experience of playing the game must be good enough for players to encourage others to buy ([Dobson, 2006](#)). Thus, the opening sequences of any game must keep the players attention while providing sufficient guidance to avoid too much frustration.

The game opens with a cinematic device specifically designed to grab attention.

Phoenix Wright opens with a cinematic clip of sorts - there is very limited animation and

the artistic style and quality is identical to that of the rest of the game. The style is similar

to that of anime - somewhat cartoon-like. The first episode is called, "The First

Turnabout" and opens with images of a crime scene.

Figure 4.6 Phoenix Wright Dialogue 1

gasp… *gasp*…
[A statue dripping with blood and a woman's body lies in a widening pool of blood set the scene.]
Dammit!…why me?
[A man stands over the body holding the statue. We see his face.]
I can't get caught… not like this!
I-I've gotta find someone to pin this on!
Someone like…. HIM.
[We see a silhouette of another man in the hallway.]
I'll make it look like HE did it!

The next screen displays text that gives the date: August 3, 9:47 AM; and a

location: District Court Defendant Lobby No. 2. As with most games screen advances

during dialog sequences are largely under player control. A small amount of text is

displayed and then the player chooses to advance to the next screen when ready. If the

game designers have done their jobs right, the player is intrigued by the mystery and

continues the game.

The mechanism used to gain attention in this game is very similar to that used in

film and television, albeit on a much lower budget. Given the murder-mystery lawyer-

show approach to the story, the introduction is consistent with the style. Consistency of

style is important if we are to ensure that players willingly suspend disbelief.

2. Informing Learners of the Objective

Let them know what is expected of them. Players learned previously from the trailers, or through word of mouth, or both that our overall objective is to investigate the case and free our client. What we still need to know is the details of the case. The next scene shows the lobby and a double door being guarded by what appear to be security guards. An exchange of dialogue follows which introduces Phoenix, Mia Fey: his boss, and Larry Butz: the defendant.

The opening dialogue sequences serve to introduce the first few characters and to give us some hints about their character and the relationships between them. We find out that Phoenix has a boss named Mia Fey, this is his first trial, and that he and the defendant share some history for which Phoenix feels he owes his client a debt of gratitude. The way this is presented visually is that the background scene remains quite static, and the character we are to meet (either Mia or Larry) appears 'center stage' for a time while the dialogue continues. The person we see does not change with the dialogue so we cannot use that to tell who the speaker is; instead each dialogue 'bubble' is labeled with the speaker's name. In this game, the animation serves more as punctuation for the dialogue than anything else. The game is very text heavy.

Figure 4.7 Phoenix Wright Dialogue 2

[Introductory Scene ends; screen goes black]
Phoenix:
My name is Phoenix Wright.
Here's the story:
My first case is a fairly simple one. A young woman was killed in her apartment. The guy they arrested was the unlucky sap dating her: Larry Butz… my best friend since grade school. Our school had a saying: **"When something smells, it's usually the Butz."** In the 23 years I've known him, it's usually been true. He has a knack for getting himself into trouble. One thing I can say though: it's usually not his fault. He just has terrible luck. But I know better than anyone, that

he's a good guy at heart. That and I owe him one. Which is why I took the case…
to clear his name. And that's just what I'm going to do!

3. Stimulating Recall of Prior Learning

Remind them of what they should already know. In the first case of the game no

assumptions are made about prior learning beyond the basic device controls. This game

does not have any other games like it, so at the start of this case players are essentially

starting fresh. In subsequent cases players get reminders of things that can be done, which

relates to retention and transfer and will be described further there. At the start of the

game players are essentially 'fed' the background information they need to know to begin

this case. This is done through the dialogue exchanges between the first three characters

that were introduced.

4. Presenting the Stimulus

Present the content. The way content is presented in this game and the kinds of

accompanying visual cues are quite differently presented in this game from most others.

Animation is minimal: the format resembles a comic book more than a dynamic game.

Most screens display what amounts to talking heads: the character that is currently the

focus of attention stands in front of a relatively static background image. It is not until

players get a little further into the game that they find out that in many cases the

background image (the 'scene') can be examined more closely. This is one way that

players can interact with the game. When players choose to examine a location, the image

of that location is loaded into the bottom screen of the DS (this is the one that is touch

sensitive) while the character in the foreground remains in the upper screen (with the

background still visible there too.) The image on the bottom screen then behaves

somewhat like a webpage: there are certain 'hot spots' on the screen where players can examine the scene more closely or read more information about some item or visible object. They may click on a desk for example and be told about some event that occurred there earlier, or discover that there is some object inside the desk which then becomes an item of evidence that can be stored when players leave the scene.

5. Providing Learning Guidance

Help learners encode and assimilate what they have learned. The tools for this game are kept in the 'Court Record' which serves the same purpose as the inventory of other games. Most games provide some place where players can store items they acquire during the game. The Court Record is divided into two sections: one to hold items found during investigations; some of which players will later be guided to present in court or to other witnesses. The other section keeps information on the people met during the game. At the start of the game the player's Evidence consists of Phoenix's attorney badge and Cindy's autopsy report. Players can click on either one to get more information about the item. The autopsy report gives the time and cause of death, but little else. The Profiles section contains information on three people: Mia Fey (Phoenix's Boss), Larry Butz (the defendant), and Cindy Stone (the victim). An important aspect of this game as in any mystery is the character development and all the people we encounter in this game have peculiarities.

As is typical of many games, certain options are available only at certain times. For example, during a trial sequence when the witness is giving a statement, interruptions or other actions are not permitted other than to page through the dialogue screens. However, when it is the player's turn to cross examine the witness, they can either press

for more information or present some piece of evidence to point out a contradiction after each statement. Guidance is also offered within the context of the game's story as well: if players seem to be getting off the track or missing some important connection, Mia appears to offer advice.

6. Eliciting Performance

Make them practice what they have learned. The first case takes place entirely in the courtroom. As with most games, the first level is simple and takes relatively little time to complete. It serves as orientation to help players understand the game's interface and acquire the basic skills they will need to play the game effectively. The gameplay choices and 'courtroom procedure' as they exist in *Phoenix Wright*'s world are shown and practiced in the first case. The judge (who is the same for all five trials) gives a short tutorial embedded as part of the story. The judge comments that Phoenix looks nervous so he will give a short test. Three questions are asked, the answers to which can be located among the information already in the Court Record. One question is the name of the victim - there is a profile on her in the court record to which players have access. If players answer the question right, they go on to the next question, but if not, Phoenix's boss, Mia Fey explains how to find the correct answer, all in character of course:

Figure 4.8 Phoenix Wright Dialogue 3

Mia
I think I feel a migraine coming on. Look, the defendant's name is listed in the ~~Court Record~~[21]. Just touch the ~~Court Record~~ button to check it anytime, okay? Remember to check it often. Do it for me, please. I'm begging you.

---

[21] Note text shown as **~~strikethrough~~** appears as RED in the game.

The tutorial is not repeated after the first case. As this case progresses, and especially in later cases, the mysteries that must be solved and the details that must be remembered become quite complex and substantial - players must be aware of clues and remember inconsistencies in evidence and testimony.

7. Providing Feedback

Tell them how they are doing. There is music in this game but it is not needed to play and the author played through most of the cases with the sound turn off. This did not noticeably detract from the game, although the sound was amusing. Through the short tutorial, players are introduced to the controls of the game and the significance of some of the details of the interface, such as ~~red colored text~~, which indicates a clue or important evidence, and that Mia appears to offer hints if players do something wrong. Sometimes the judge also indicates an answer was incorrect, and players cannot proceed in the game until the correct response is given. Later in the game players are not allowed to proceed to the next chapter until all the needed evidence has been gathered and all the witnesses have been heard from. This game is far more structured and offers the user far fewer choices than most modern games do, and yet this game has become one of the highest rated titles of its year. The format in and of itself does not appear to be a design liability.

8. Assessing Performance

Let them know how they did at the end. This is a game 'on rails', which means players must come to the right conclusion and there is only one path to winning this game. In fact there are only two possible outcomes: a guilty or not guilty verdict and a not guilty verdict results in having to repeat sections of the game until the correct

response is elicited. Individual cross examination sequences will also be repeated until the right evidence to present is found, or players run out of chances. The sequence may be repeated as often as desired so long as no unfounded objections are made. There are a limited number of chances to win each section (usually five - displayed as exclamation marks on the screen) and each time evidence that does not help is presented or a faulty objection is raised one of those chances is lost. Once out of chances our client is pronounced guilty and players must start again from the beginning of the last chapter. Frequent and immediate feedback is provided on all actions, and each time a round is lost, players may begin again, either at the start of the chapter or the last place where the game was saved. The game can be saved at any point where player interaction is permitted, so a save point can be set almost anywhere.

As is common in most games, players may lose, but will never be prevented from trying again. Part of what encourages such persistence in gamers is that it is assumed that there IS a way to win, and that players can keep trying until it is found ([Salen & Zimmerman, 2004](#)).

9. Enhancing Retention and Transfer

Help them remember and apply what they have learned. There are several levels at which retention and transfer can occur in games. For example, the functional details of how to operate this particular game are useful for the duration of this game and any sequels that might follow. More generally speaking, game genres contain similar functional interfaces as well as similar goals, challenges and reward structures (see also description of 'game evolution' in [Chapter Six](#)). Just as learning about the structure of math textbooks in a general way can help to reduce the orientation required for the next

math book, learning about the structure of various game genres allows players to get to the interesting parts of the next game faster. Having experienced *Phoenix Wright*, players are likely to be able to approach the next branching-story style game with certain expectations of what they can do and what they must do as well as what they should not expect. Ultimately this kind of generalization can become habituated.

Finally, even though this game makes no claims about value beyond entertainment, there are still higher-order thinking skills that are being practiced in the course of this game, such as paying attention to and remembering detail; looking for contradictions in facts; and matching clues with events. While this game was not designed to be educational, the format, style, and even the lawyer premise could be useful devices to foster the development of these skills more realistically and accurately if used in an educational game than happens now in *Phoenix Wright*.

Reigeluth's Elaborations and the Animal Crossing Space
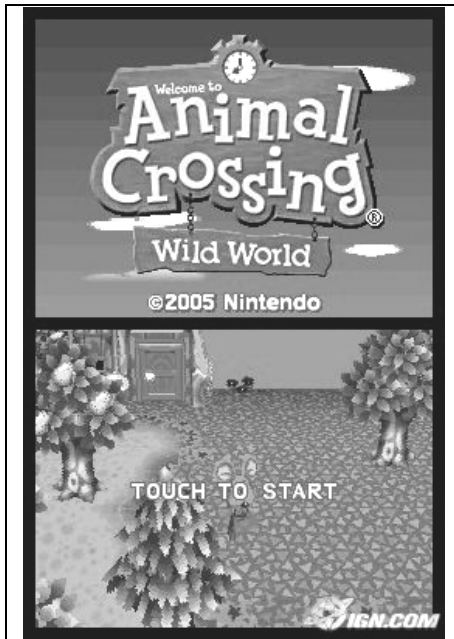
Figure 4.9 Animal Crossing Wild World

image source: IGN.com

Jean Piaget gave us the notions of the pre-, concrete, and formal operational stages of development, and both John Dewey and Herbert Spencer advocated that the organization of learning should progress from simple to complex as it does for all human development. Ausubel and Bruner advocated the organization of learning in increasing order of complexity; Ausubel used this notion to help form his subsumption theory and the concept of advance organizers, and for Bruner this took shape in the notion of constructivism - one of the most significant learning theories of the late twentieth century.

All of these contributed in laying the groundwork for Reigeluth's Elaboration Theory (Reigeluth & Stein, 1983). A key argument for this approach is that learners need to develop meaningful contexts to which they can anchor new ideas and skills, and that this will in turn aid in transfer and retention. One of the most critical components in this scheme is the proper sequencing of instruction, which increases learner motivation and allows for the formation of stable cognitive structures. When this theory is viewed in the context of video games, once again, the organization and design of most good games already meet many criteria for well-organized and properly sequenced instruction.
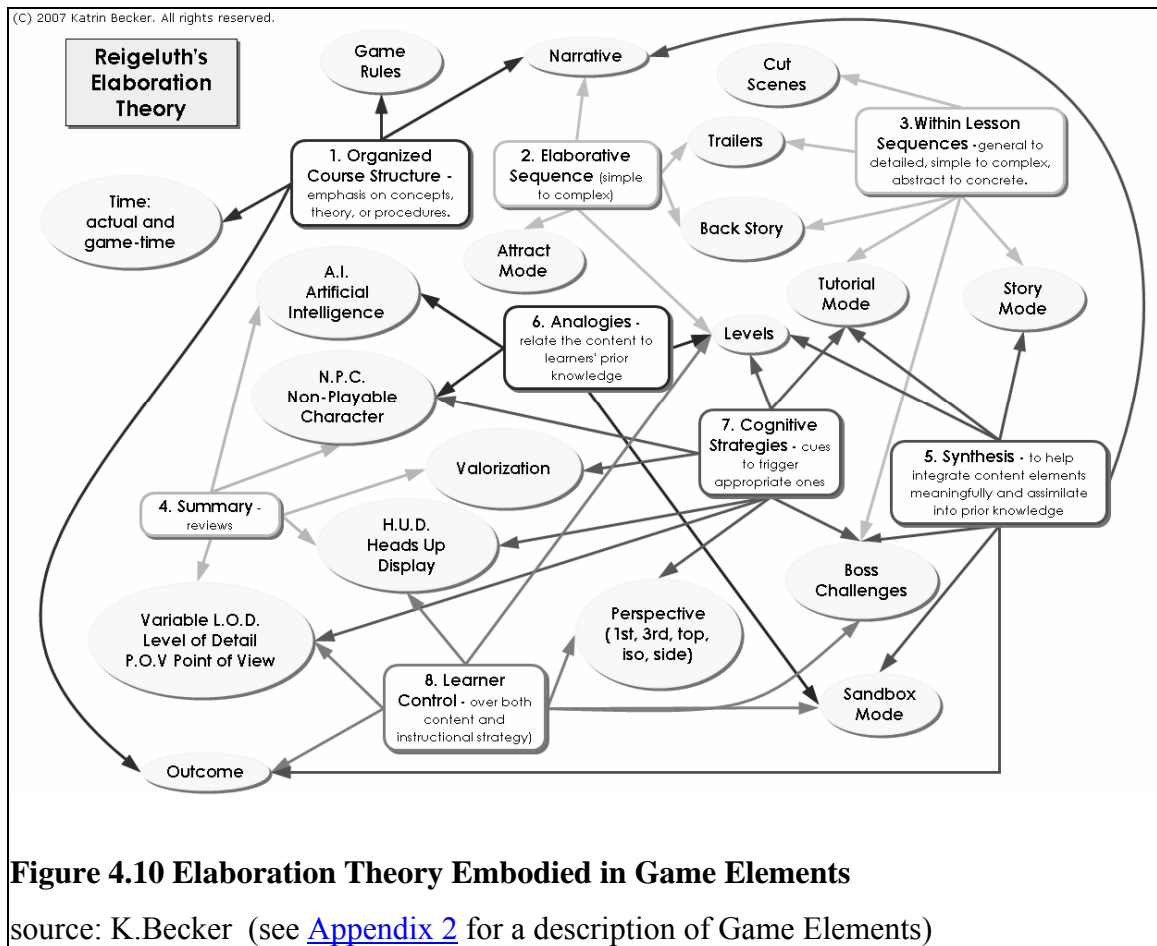
Figure 4.10 Elaboration Theory Embodied in Game Elements

source: K.Becker (see Appendix 2 for a description of Game Elements)

Reigeluth's Elaboration Theory (Reigeluth & Stein, 1983) is a macro level

prescriptive strategy that builds on the work of Gagné (1977), Ausubel (Ausubel,

Hanesian, & Novak, 1978), Bruner (Bruner, 1966), Merrill (Merrill, Li, & Jones, 1991a)

and many others of the late 60's and 70's. The goal was to integrate the then current

knowledge on how to organize instruction in the cognitive domain. Many of the concepts

unified in this model, such as the importance of selection and sequencing, instruction that

progresses from simple to complex, and review strategies remain as relevant to modern

teaching and instruction as ever. When viewed through this lens, digital games have

many elements that connect with an elaborative approach to learning - in many games,

each level builds on the previous one, incorporating and building upon acquired skills and experiences. To show how this might be, the preceding concept map (Figure 4.10) shows each of the elements of the Elaboration Theory connected with various game elements. For example, learner control over both content and strategy is common in and is often embodied in the level of detail and perspectives available within a game, the player's ability to choose to focus on various aspects of a game and ignore others, and the ability to move around the game space. If we examine a single game we are likely to find the one game does not use all the available mechanisms to embody these elaborations, but in any good game, it is highly likely that each elaboration will be supported in some manner. To test this assumption, an examination of *Animal Crossing Wild World (ACWW)* follows.

1. Organized Course Structure

Organize the 'course' structure to emphasize its primary focus. The primary underlying principle in this approach is the elaborative sequence from simple to complex, general to detailed, and abstract to concrete. For each distinct (single) type of content there will be a clear emphasis on concepts, principles, or procedures, and this can be seen in ACWW also. The main emphasis in ACWW is on procedures - doing things, and this is reinforced by the game's rule structure and its narrative as indicated on the back of the game box: "Whether you want to decorate your home, join in on special events, or just chat with the locals, there's always plenty to do!".

However, once players are familiar with the basic procedures, they can choose to focus on either procedures or principles, as one way to take up this game is to try and develop the relationships among the residents, which requires players to develop various

theories and principles about how best to foster 'friendships' with the NPCs of the game. The game facilitates both approaches (procedural and principal), but the remainder of this example will focus primarily on the procedural aspects.

2. Elaborative Sequence

Start with simple and basic ideas and progress to the more complex ones. Most of the activities one can engage in are first introduced in a simple form. For example, the player's house begins as a small cabin. It is possible to decorate and furnish the main room of the house, but there is a limit on how many items can be placed in the house. As the player earns money and pays off the mortgage, the size of the house grows, and with it the number of items that can be placed inside. Further expansions add new rooms, which mean that each room can be decorated differently. At the beginning of the game players are given a small number of specific tasks to complete over which they have virtually no choice - they cannot continue with other activates until these are done. Limited options are enforced by the fact that players have no tools or money and by the fact that Tom the shopkeeper who hires the player to work for him is also the character who will become the main source of income as he sells and purchases items. Players are highly motivated to comply because one of the few ways to acquire money is through the sale of goods to Tom. Small amounts of money can be shaken out of some trees, and with a shovel, money can be knocked out of a rock (a different one each day), but a shovel cannot be purchased until the tasks that the shopkeeper has given are completed. In this way players are forced to go through the 'training period'. As the required tasks are completed players are given more information on the kinds of goals that can be pursued, as well as specific instructions.

In the following dialigue, 'Pixel', the player's avatar has been given the task of delivering a piece of furniture to Gaston for Tom. When Gaston is approached, he begins the dialogue and one of the response choices is one specific to the current situation, namely , "Delivery!". This option does not usually appear. Once the player has handed the furniture to Gaston, he offers a brief tutorial on how to move furniture around in the player's house.

Figure 4.11 Animal Crossing Wild World Dialogue 1

[Player instigated exchange; August; afternoon; outside; third task: furniture delivery]
Gaston:
Oh! Is it a half day for you, **Pixel?**
So anyway, did you want something from me, or what, mon chou?
        Delivery!
        I'm killing time.
        Uh, never mind.
Pixel:
Choose 'Delivery!':
[inventory page opens; furniture item for Gaston is the only item accessible.
Choose 'give this'; it gets handed over]
Gaston:
Huh? Why are you delivering furniture, **Pixel?**
… Hah! So you're **Tom Nook**'s little servant? Have fun with that!
If you can't pay up, you gotta work for it! Eh, mon chou?
…Well, you ARE lookin' a little sad and pathetic, so I'll help ya out.
Here… take my *SHOWER*
Nahhh! No worries. There'll be plenty of time for you to do me favors later.
In the mean time, practice your decorating skills with what I just gave you. Just drop it in your room and then *TAP* your head, mon chou!
Then you can *SLIDE* it around! Just push, pull, or rotate it any way you want.
Don't forget to *TAP* your head when you're standing next to some furniture.
…Knowing you, that tip will probably be out of your brain in a hurry.
So run home and try it before it leeks out of your ears, mon chou!

3. Within Lesson Sequences

Repeat the simple to complex progression within each task. Each kind of task begins as a simple procedure, and as the game progresses, players must become more

sophisticated in how they carry out these tasks. The beginning of the game guides us

through the basic procedures we will need to be able to explore and make progress: we

begin inside the town hall where the character behind the counter will ask us if we need

help. We are told about Tom the shopkeeper, and we are given a map of the town with

directions to our house.

Figure 4.12 Animal Crossing Wild World Dialogue 2

[NPC INSTIGATED EXCHANGE; August; morning; first arrival (but not
player's first avatar); in Town Hall; player 's character is named Pixel]
Pelly:
Well, this is **KAFBURG'S** town hall…
So, what is it I can do for you today?
   I moved in!
   I came by cab!
Pixel:
Choose 'I came by cab!':
Pelly:
…Oh. Goodness me! You must be **Pixel**
Welcome!
I'm *Pelly*, and I'm the clerk here!
Tom Nook already told me all about you.
So you'll be living with **Kaffy**and **Minki**, is that right?
That sounds like a lively bunch to live with, now doesn't it?!
Well, we have many residents who live all around **KAFBURG**.
Please let me show you where your house is. It's here!
[map is displayed showing house, circled, and with moving hand pointing to it.
Our current location is also shown as a flashing silhouette of a person]
Well then, **Pixel**… I trust you can use this *MAP* to find your new home!
Oh, wait! Do you know… how to pull your *MAP* out?
   What?
   Yep
Pixel:
Choose 'What?':
Pelly:
To check your *MAP*, tap the <u>*ARROW*</u> in the upper-right corner of the <u>*TOUCH SCREEN*</u>.
Then touch the <u>*HOUSE ICON*</u> along the top.
You can also press the <u>*X BUTTON ON YOUR NINTENDO DS*</u>.
All right, then, good-bye, and please come again!

At the avatar's house Tom hires the player and gives seven tasks to complete, one at a time. This serves as a basic orientation for how to interact with the townsfolk (players must interact with each one in order to proceed), change clothing, plant flowers and trees and do a few other things. During this time the residents also tell about the four main tools: a fishing pole, a shovel, a watering can, and a butterfly net. With the exception of the shovel these each have one purpose which is also explained.

Players learn about most aspects of the game a little at a time: the first errand involves delivering a carpet to one of the residents. When delivered, a little information on how to decorate the home is provided, but it is not until the appearance of our room has been changed that any residents offer further information. It is not made explicit that more hints will be provided after something has been tried, but the residents sometimes ask for favors. Since the mechanisms exist to monitor and record all activities within the game, it is also possible to provide additional detail as it appears to become relevant. Although these tips may be delivered at any time by random chance, they are ALWAYS elicited under certain circumstances, so for example the comment that flowers don't need watering during rain may appear randomly at any time, but one of the residents is certain to approach to say this if it is currently raining.

4. Summary

Review at both the micro and macro level. A key aspect of the Elaboration Theory is its emphasis on the value of timely review. The Theory also dictates that systematic review is important, but games are rarely that structured. Nonetheless, review remains an important and integral feature of ACWW in a number of ways. Certain states always trigger certain responses. The game is after all, a computer program and there can only be

a finite (often small) number of ways the game can proceed from any particular point.

ACWW uses various mechanisms to trigger review, most of which are delivered through

'conversations' with the other residents, all of whom are NPCs. For example, if one of the

residents is approached for a conversation and the avatar has been stung by bees, an

exchange such as the following is likely:

Figure 4.13 Animal Crossing Wild World Dialogue 3 & 4

> [player instigated conversation; August; bitten by bees; evening; outside; town
> fireworks are on]
> *Aurora:*
> Aaieee!!!
> Whoa! Don't scare me like that, **beefcake**
> Sheesh! Look at you. It's like you got stung by every bee in town…
> Listen, next time, just run straight to the nearest house. Don't u know!
> Bees can't use doors! In the battle of man versus bee, doors are your savior!
>
> ---
>
> [player instigated conversation; August; evening; in Purrl's house. I've been bitten
> by bees]
> *Purrl:*
> And today's doofus of **KAFFBURG** award goes to….
> Your face!
> For the esteemed winner, **Kaffy**, I would suggest some lovely *MEDICINE*
> These two exchanges give the player tips on how to deal with bees - they may be
> repeated whenever the player begins a conversation while showing evidence of a
> bee sting.

5. Synthesis

Make the content structure explicit with visual and other objects. Synthesizers are

used to integrate content in a meaningful way and to help learners assimilate prior

knowledge. They can be used to organize elements horizontally (relationships among

ideas in a single lesson) and vertically ('relationships between ideas in a group of lessons,

and the general and inclusive ideas that contain them' (Reigeluth & Stein, 1983, p.360)).

One of the mechanisms used in *ACWW* that acts as a synthesizer is that of repetitive

patterns. While it may have been included for efficiency of data space and programming in design, the practice would not continue if it did not also help players. Dialogue sets have specific styles related to the 'personality' of the NPC and players can learn what kinds of responses to anticipate. For example, residents will ask the player to answer a question from time to time. The appropriate answer is sometimes rewarded by the NPC giving the player a gift and which answer is appropriate depends on the personality of the NPC asking the question. So learning to associate certain types of responses with certain types of residents results in rewards.

Figure 4.14 Animal Crossing Wild World Dialogue 5

> [NPC INSTIGATED EXCHANGE; August; early morning; outside]
> *Bella:*
> Oh, hey there! **Beefcake**, I'm thinking of getting a new pet fish.
> So what's a good name for my new fish, eeks?
> > Ruby
> > Sushi
> > Jaws
> > Mr. Fish!
> *Kaffy:*
> Choose 'Ruby':
> *Bella:*
> Yeah! That's cool!
> I mean, REALLY cool! Thanks, eeks!
> OK, **beefcake**, since you helped me name my new fish, I'll give you this!
> Here!! It's not much, but I really want you to have my *MODERN BED*
> Love it like it was your own….because it TOTALLY is now, eeks!
> [item is exchanged during last statement]

There are also some fairly sophisticated vertical synthesizers that players can recognize and work with, but the choice to pursue the implications of these relationships is always with the player. In *ACWW*, there are many kinds of collections that can be taken up in this game and each is rewarded in different ways, some of which involve relationships not immediately obvious from the game. One of the most sophisticated ones

is that of furniture collecting and the interior design of your house. For example, the manner in which players decorate their houses can be left entirely to personal taste, but this aspect of the game, as almost any other has an underlying principle which can be used to improve one's score in that area. Players have their houses rated from time to time by the "Happy Room Academy" - typically after a new item has been added to the home. The rating of the home makes use of several concepts, including furniture 'collections' (all of the same style), special items, and the house's Feng Shui. In this way the arrangement of items within the house can become more than random or player whim - there is a 'system' that can be discovered and followed.

6. Analogies

Use analogies that connect with prior learning. If we look at it from the proper perspective, the entire game can be seen as an analogue of activities from real life: earning a living; building relationships; achievement through contests, etc. One of the main functions of analogy is to relate content to the learners' prior knowledge so learners can assimilate newly presented ideas. Another thing that makes analogy a useful device is the ability to create connections that not only reach backwards to what we already know, but also to provide a path for forging forward connections. When we encounter a new situation we will have a frame of reference already built. *ACWW* does this too - the concept of a mortgage that must be paid off may be familiar to adult home owners, but probably not to younger people playing this game. Through this mechanism, complex and sophisticated ideas can be introduced and players can be guided towards understanding them.

While there are many analogies to real life in *ACWW*, it must be remembered that this game was intended as an entertainment and not as a serious trainer in life skills. As such, the 'life' analogies are unreliable. Still, part of what makes the game compelling for many players is its mimicry of life, Utopian style ([Waugh, 2007](#)). The mechanisms appear to be effective.

On a more detailed level, analogies are especially useful when introducing difficult and unfamiliar ideas. *ACWW* is not intended to be difficult and as a result there aren't many places where analogies are required for learning within the game.

Figure 4.15 Animal Crossing Wild World Dialogue 6

> [player instigated conversation; August; bitten by bees; evening; outside; town fireworks are on]
> *Aurora:*
> Aaieee!!!
> Whoa! Don't scare me like that, **beefcake**
> Sheesh! Look at you. It's like you got stung by every bee in town…
> Listen, next time, just run straight to the nearest house. Eeks!
> Bees can't use doors! In the battle of man versus bee, doors are your savior!

7. Cognitive Strategies

Use a variety of devices to help trigger appropriate processing strategies. Most games employ many cognitive strategies intended to help players discover what they need to know and to remember what they have learned and often games use similar approaches, such as different colors of text to mark specific things. Some of these strategies are so common that they could arguably be considered aspects of basic games literacy. The use of colour in text displays is one strategy that is commonly used to indicate classes of words, items, clues and so on. In *ACWW*, names of items that can be collected are displayed in *MAUVE*, references to the operation of the game are *DARK*

YELLOW, names of other residents are in *pink*, the name of the town is **GREEN**, and the player's name is in **blue**, even if a nickname is being used instead of the chosen name. This way, even if a word is being used for the first time, the player will be able to classify it and thereby know what can be done with it.

Figure 4.16 Animal Crossing Wild World Dialogue 7

> *Tom Nook:*
> If you want to use your fishing rod, grab it from your pockets, and you're ready to go, hm?
> ………….
> *Pudge:*
> YAAAAAAWN! Good morning…
> Everyone in **KAFBURG** gets up so early.
> I'm *Pudge*… I'm better at wrestling and eating than anybody.

Another common strategy is to restrict the player's options at various times. When trying to sell items at Tom Nook's store, for example, only those items Tom is able to buy are accessible in the inventory even though the player may have other items in the same place. The others are still visible, but appear faded (i.e. in the background) and cannot be grabbed or moved. In this specific situation inaccessible items include such things as money, which Tom does not buy. In other situations the subset of accessible items will be different, and occasionally the items may be 'grab-able' but cannot be used. It is possible to attach items to letters we may send to other residents as gifts, but some kinds of items (like fish and bugs) can not be attached and simply will not 'stick' to the letter if dragged over to it.

Suppose the player decides to pay off the mortgage. The first mortgage amount is 19,800 Bells, and at the start of the game the player has no tools so there are few ways to earn money. If they wander around, various residents will explain that fruit can be shaken

out of trees and shells picked up at the beach. Tom the shopkeeper will buy whatever has been collected and as soon as enough money has been acquired to buy some of the tools, players can begin to fish, catch bugs, and so on and they are well on their way to meeting their goal.

8. Learner Control

Encourage learners to exercise control over both content and instructional strategy. Because *ACWW* is an open-ended role-playing game, one would expect to have much latitude when it comes to exercising control. Player control is possible in many places in the game and at many levels of abstraction, starting from the look and feel of the game and the main character, to how the NPCs sound, but the greatest latitude in this game is afforded in the game play itself. Players may choose to focus on as many or as few aspects of the gameplay as they like. They may decide to focus on collections, making money, interacting with the other residents, or even fashion design.

Text is displayed in small chunks, but users are given the option of scrolling through text faster if they want. Most dialogue is given to the player no more than a dozen words at a time, at the end of which the user must use a control to go to the next bit. Another way that many games provide control is with the appearance of the player's avatar. *ACWW* players may choose their character's gender as well as various other things before the game begins, but in this game the process is presented as part of the game's introductory sequence rather than a pre-game activity. At the beginning of the game while the character is riding to town in a cab, the taxi driver asks the character various questions and makes various comments. Players have the opportunity to respond at

several points, and those responses determine the character's gender, eye color, hair style, and several other things.

'The next question asks how you like the name, and is the first step toward determining your character's gender. If you select "That's not it" then you can re-enter a new name in case you made a mistake. If you tell him you think the name is cute, he'll think you are a girl. If you tell him it's burly then he'll think you are male. After this question you will have the opportunity to select "I'm not a boy/girl!" if you chose the wrong one, don't worry.' (Eagleson, 2006)

Merrill's First Principles of Instruction Starring Mario

Figure 4.17 The New Super Mario Bros.
image source: IGN.com

M. David Merrill's career in instructional technology has spanned 40 years, and includes numerous significant contributions to the field. For many he is best known for his Component Display Theory (Merrill, 1999). In the 1990's he was one of the foremost proponents of 'Second Generation Instructional Design (ID2)' (Merrill, Li, & Jones, 1991b) which acknowledged a more open-ended and less prescriptive approach to ID, and included Instructional Transaction Theory (Merrill, Li, & Jones, 1991a) and ID based on knowledge objects.

The First Principles of Instruction are the result of a systematic review of instructional design theories, models and research. Each of the principles included satisfies the following properties:

1. promotes more effective, efficient or engaging learning,

2. is supported by research,

3. is general enough to apply to any delivery system or instructional methodology, and

4. is design oriented with direct relevance to promoting learning activities.

Merrill defines a 'principle' as a basic method, and describes it as a 'relationship that is always true under appropriate conditions regardless of program or practice (variable methods).' (Merrill, 2002, p43) There are five principles that constitute a set of fundamental elements common to all effective instructional design. Merrill hypothesizes that 1) 'Learning from a given instructional program will be facilitated in direct

Figure 4.18 Merrill's 1st Principles Embodied in Game Elements

source: K.Becker (see Appendix B for a description of Game Elements)
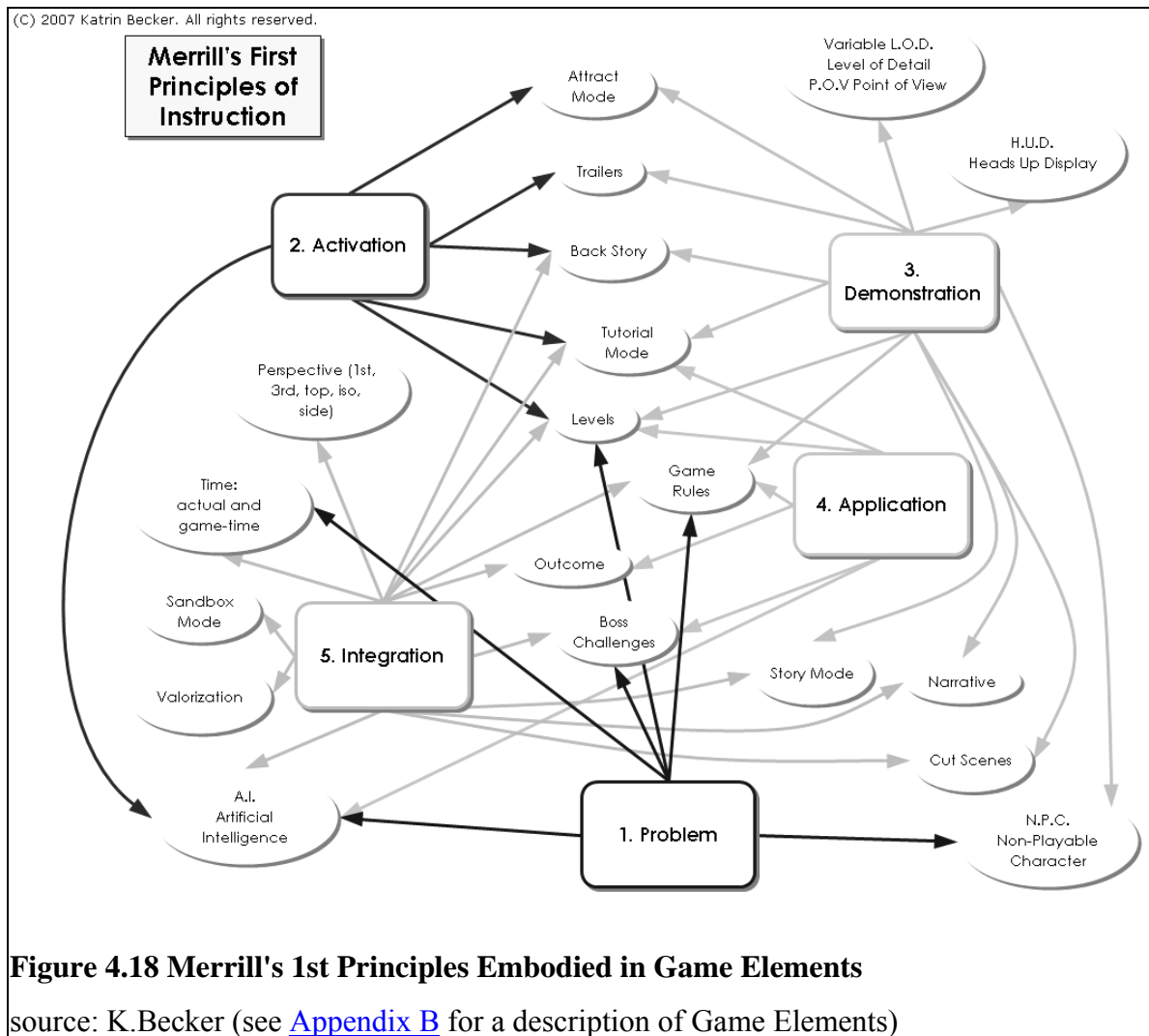
proportion to the implementation of first principles of instruction', and 2) the 'learning from a given instructional program will be facilitated in direct proportion to the degree that first principles of instruction are explicitly implemented rather than haphazardly implemented.' (Merrill, M. D., 2002, p43) If true, then illustrating connections between game elements and Merrill's First Principles would suggest that games facilitate learning in substantial ways.

Problem

Engage them in solving real-world problems. Obviously, claims that the actions within *The New Super Mario Bros.* emulate any sort of real-world problem other than an obstacle race would be a stretch. However, if we take it to a higher level of abstraction, the challenges of practice and rewards associated with incremental progress could be described as real-world problems. In this case however, I would argue that the real-world nature of the problem is less important than that it be engaging, and for millions of players, *Mario* is certainly that. Parables, fairy tales, and fantasies can all be engaging and can all relate, even if only indirectly to real-world problems. Again, in this example it must be remembered that the object of this study is not so much to discover how this game is educational as it is to discover how the mechanisms used in this game embody the educational principles outlined.

Activation

Start where the learner is. In most successful games trailers, back stories, and tutorials all contribute to helping the player become familiar with the game and its basic rules and objectives. Being a commercial enterprise the designers would naturally want to attract as large an audience as possible, so many 'first' games assume little more than basic knowledge of the game equipment, whether it be a console, handheld device, or a PC. Some 'numbered' games (*Final Fantasy XII*, *Call of Duty 3*, and other sequels)

assume prior knowledge through having played previous editions of the game, but those that rely on this too heavily also restrict their audience and that is rarely desirable in a commercial context.

Each *Mario* game has similarities with each other, but players need not know anything about any one of them to play and enjoy any other. Successful games almost always have simple challenges at the beginning that shift more or less gradually to ones that can be surprisingly difficult. *Mario* allows players to replay any level they have already completed, providing a considerable degree of flexibility and the option of returning to 'familiar' territory to regain confidence before attempting a particularly tricky course.

Demonstration

Show people what we want them to learn, not simply tell them. In an effort to ensure that learners come away from our lessons with all those things we feel are fundamental or essential, we sometimes provide too much demonstration. This is especially true when the learners are gamers as they are accustomed to trying things out after only minimal tutoring. After all part of the fun in a game comes from discovering unexpected places, treasures, and how to do things while poking around and learning how to play the game. Learning is not usually efficient, and the commercial game designer's desire to keep players engaged with their games as long as possible supports that notion well.

There are a great many devices used to indicate what players need to learn in order to win a digital game. It is assumed that we understand the basic premise, and this is facilitated through the use of an introductory cinematic clip. In this game, we see

Mario and Princess Peach out for a walk together, a disturbance at the distant castle distracts Mario and while he is away investigating Bowser sneaks up and snatches the Princess away. In the opening cut scene of the first level we catch a glimpse of Bowser carrying Princess Peach into the tower which is also one of the courses we must complete, but from where we are there is no path by which we can reach it. Thus, we conclude that we must somehow build or generate a path to that tower so we may have a chance to go in and retrieve her. Basic games literacy includes the knowledge that moving, flashing, or otherwise highlighted items in a game are almost always significant, so these should be hit, shot, picked up or otherwise acted upon. It also includes the sure knowledge that there IS a way to win. In Mario, the way to generate new pathways is to enter each course, and get to the end while collecting as many points as possible. Along the way we are shown star coins we can grab, and hints at hidden pathways. This is a game after all, so it is assumed that the hidden pathways will reveal something of value. A typical game is expected to offer twenty or more hours of gameplay, so any game that demonstrates too much of what we need to learn and does not allow us enough opportunity for discovery (i.e. one that is too easy) is unlikely to become successful.

Application

New knowledge must be applied to solve problems. The whole point of a game is to meet some challenge or solve some problem, preferably many of them. Given that Mario lacks a rich back story, the puzzles and challenges are entirely the point of this game. Each level offers several new challenges as well as increasing levels of difficulty on previously mastered skills. The first level of any 'world' will introduce the basic maneuvers used throughout that set of courses. After discovering that some blocks

release points and others release power-ups one of the first things we will do when we come across a block is to hit it to see what happens. In doing so we also discover (usually too late at first) that some blocks break away when hit, which may deprive us of a needed ledge or jumping off point.

Integration

Learners are motivated to apply what they have learned. Each course also presents the player with new situations and challenges that call for application of what has already been learned, but in new ways. The set of 'skills' required to survive to the end of the first course is quite small, but each time we proceed on to the next course we bring those skills with us. Having learned that we have some control over the speed at which Mario runs, we encounter a log we must cross that teeter-totters. The motion becomes exaggerated as soon as we jump on and so we must move at the appropriate speed to get across without tipping it too far and sliding off. One of the hallmarks of successful games is that they almost always provide the player with many opportunities to practice and apply any skill learned within the game. In fact any time a new skill is acquired in a game it is assumed to have some additional purpose later on. This assumption provides considerable motivation to players to spend both the time and the effort to acquire skills, and a game that requires players to learn skills and gain knowledge that are then never used again tends not to remain popular for long.

Activity Theory and Animal Crossing
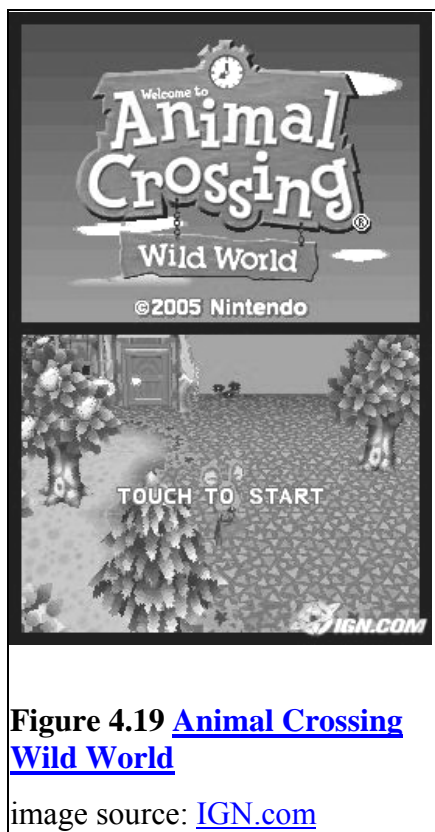
Figure 4.19 Animal Crossing Wild World
image source: IGN.com

Activity theory is not new, though its roots are elusive, but many have contributed to this line of thought, including Lev Vygotsky (Vygotsky, & Cole, 1977), A.N. Leont'ev (Leont'ev,1978), and A.R. Luria (Luriëiìa,1976) in Russia. The main focus of this theory revolves around the interrelationship of the subject (the learner), the object (the goal which leads to the outcome), and the tools (both physical and conceptual) used to mediate between them. It suggests that the relationship between objects in the environment and people are mediated by culture and its rules, the community, and by labor and its roles and development.

Others have already applied this theory to games (Dobson, Ha, Mulligan, & Ciavarro, 2005; Hadziomerovic, & Biddle, 2006; Oliver & Pelletier, 2004; Squire, 2002) and have studied it in the context of player learning. The current effort examines games and activity theory from the perspective of the game design and in that respect also expands on work in human computer interaction (Kuutti, 1996). Very loosely described, in this view of activity theory, the subject is thought to form a relationship with the tool, but that the tool only becomes a tool through the user's activity. While the current examination cannot fully detach the user's relationship with the game, the focus here is more on the design of the artifact (the game) and how that design embodies the concept

of this theory. Also, Kuutti ([1996](#)) has defined three levels of analysis that are also useful

to examination of games through activity theory ([Pelletier, & Oliver, 2006](#)), namely:

strategic level activities (such as paying off a mortgage or completing a collection),

tactical actions (like catching a fish or gathering fruit off a tree), and operational actions

that follow a particular pattern that can become automatic (like giving Tom Nook items

you wish to sell from your inventory, or like fishing) so long as nothing goes wrong

causing a contradiction (like being bitten by a mosquito while fishing).
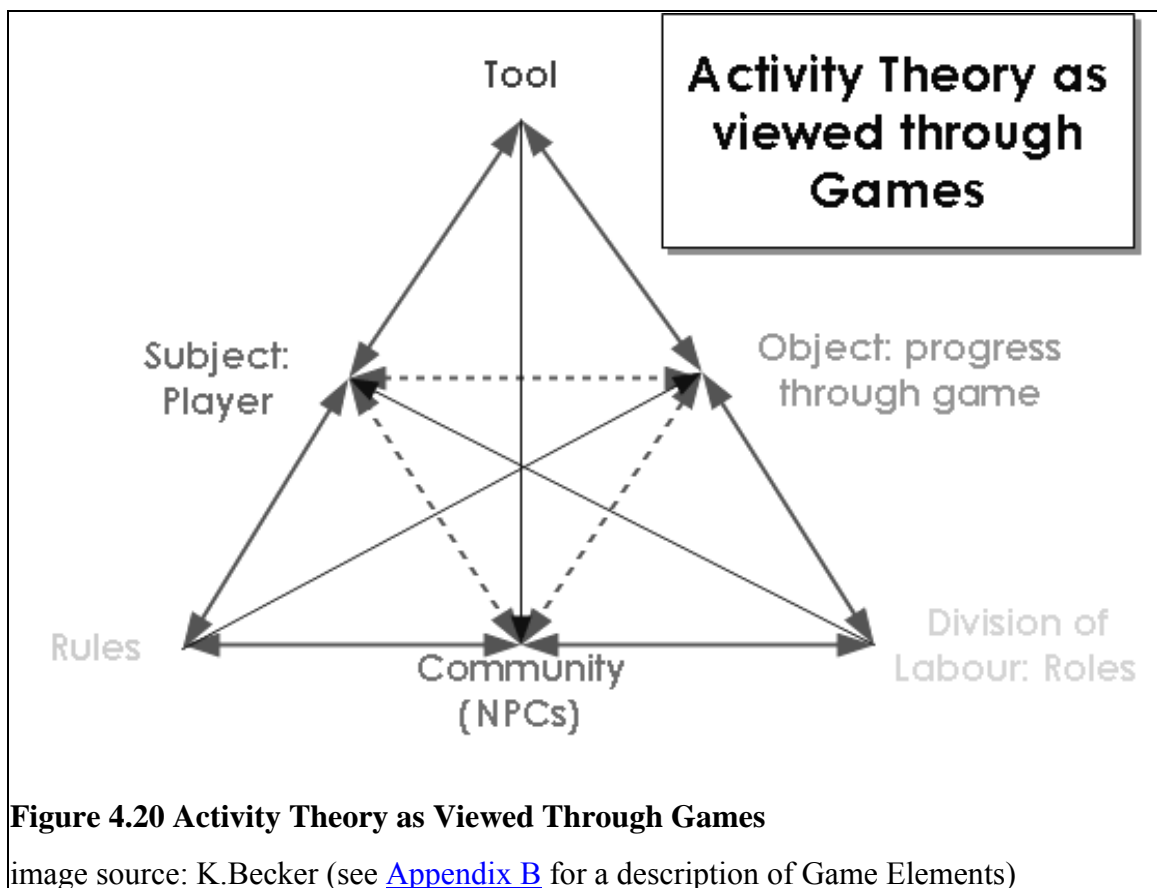
Figure 4.20 Activity Theory as Viewed Through Games
image source: K.Becker (see [Appendix B](#) for a description of Game Elements)

Activity Theory is descriptive rather than predictive, and as such offers a useful

perspective through which to view the design of games.

Subject

The main subject of any game is the player of course, and in *ACWW* players may take on several characters, but not simultaneously. As many as four player/residents can 'live' in one *ACWW* game but whenever one is awake the others will always be sleeping. These other characters are still distinct in terms of assets like money and possessions, and their relationships with the other residents. This game is played from a third-person perspective so the player, while likely identifying with their character, sees that character act within the game. This perspective adds a degree of distance for the player as the play experience is more akin to playing with a doll than pretending to be someone else.

Object

In *ACWW* the choice of object affects how the game will best be played, although this game does encourage some activities more than others. The main ones include: relationship building, collections, money making, the "stalk" market (the commodity of trade is turnips), and gardening (which includes fruit and money trees as well as flower breeding that can result in the production of various new colors). Different approaches are appropriate for different objects, but they are all introduced early in the game, after which the player is free to focus as desired. Players need not commit to any specific goal and may change their focus as often as they wish.

Tools

Tools serve as mediating elements in any activity and can be physical, conceptual or symbolic. They include instruments, signs, procedures, machines, methods, laws, and forms of work organization ([Jonassen, & Rohrer-Murphy, 1999](#)). If we stretch the notion of physical to include in game artifacts with which the player can interact, then all three

exist within many games. *ACWW* has a great number of artifacts and objects but not many classes of objects, and even fewer actual tools that can be used to achieve goals. There are six primary 'physical' tools in *ACWW*: a shovel, a fishing rod, a watering can, a butterfly net, an axe, and a slingshot. Examples of conceptual tools include: humor ([Dormann, & Biddle, 2006](#)), relationships that develop between the player and the NPCs with which we interact and over which we have varying degrees of influence, and the use of time, which can be considered a mediating tool as well as having ties to the games rules, and will be discussed further in the next section. At its most fundamental level, the entire game is a symbolic tool but that does not help us further our analysis so we look in the game. Here we find that the symbolic tools include such things as special events, changing seasons, lucky furniture items, silhouettes of fish seen underwater, and so on. All of these artifacts can be used by the players to support progress towards the object and outcome.

Rules

Among the defining characteristics of any game are its rules to the extent that a game without rules may not even be termed a game, and in a role-playing game, those rules tend to be fairly complex. *ACWW* has both explicit and implicit regulations, norms, and conventions that constrain individual action and group interaction. There are positive or negative consequences to almost every action, although in this game the connection between the act and the consequence is often not direct. There are for instance ways to increase one's 'luck' when fishing, which include placing lucky items in our house. Fish appear at random according to a predetermined probability but this can be affected to a

certain extent by our own actions. Lucky items placed in our house increase the likelihood of the appearance of rare fish.

Rules of interaction both with the game environment and with the NPCs are enforced in *ACWW* largely by restricting the user options and also by the way in which the NPCs respond. If we ignore or deflect requests for interaction by residents too often they are likely to stop giving us gifts for example. Residents will move out of our town from time to time, but how we respond to them will often affect when this happens. Since there is no single win state in this game, there is also no single lose state, and the game can continue indefinitely providing essentially endless opportunities to try again even without restarting the game.

In *ACWW*, game time is intended to match real time and certain events take place on a regular basis (weekly visits by occasional characters, daily replenishment of the shopkeepers stocks, annual special events, etc.). These events are tied to the game's calendar and clock and although players can adjust the clock forwards and backwards, each day that is 'skipped' still exerts influence. For example a small number of new weeds will grow each day (we are supposed to help keep our environment nice by tending the area), if we skip ahead too many days we may find our town overrun with weeds and that the flowers have wilted away. Also the lack of interaction with the residents will prompt many of them to move away.

Rules underpin all progress in digital games.

Community

All three games being examined are being considered only in the single player mode as it is the design of that game itself rather than the social interaction of various

human subjects that is the focus of this discussion. Given that, the individuals or subgroups who share the same general object include only those NPCs who are "on my side" or who are designed to assist the subject rather than hinder her. In *ACWW* there are a total of twelve regular residents (such as Tom Nook the shopkeeper), 16 occasional visitors and 144 villagers, each of which has one of six distinct personalities (Eagleson, 2006). The town regulars are largely benign and will help out according to their roles, while the occasional visitors are largely beneficial (although a few are scoundrels!) and each of these also has specific roles as well as peculiarities. Of the 144 villagers, a maximum of eight may reside in your town at any given time. Conversations are not free form and in fact very few modern games offer anything but the most rudimentary forms of language recognition. Most conversations involve a pre-determined (or randomly selected) phrase that is displayed, followed by several potential responses from which you may choose.

Division of Labor

The division of labor in a game activity system comes from the ways in which the community is organized. In most games the division of tasks between members of the community is quite well-defined and it is not uncommon for individuals or groups to exist specifically to serve tightly defined roles. In *ACWW* the regular residents have roles associated with a specific space. Occasional visitors have similarly specialized roles but tend to be more mobile. Lyle the insurance salesman (a weasel) appears once a week solely to sell insurance, and hangs around our house. Tortimer the Mayor for example is only found outside the town hall, and ONLY during special occasions. Blathers the owl can be found only in the museum. In games this mechanism helps to compartmentalize

the behaviors and possible actions, thus controlling the game design's complexity while at the same time allowing for player flexibility. From a learning perspective each character and location becomes associated with specific activities and acts as a mnemonic that players can remember to provide a scaffolding effect.

For the player, activities and roles can change as the tools do, but these roles are the ones that the player decides to take up, whether it be gardener, collector, fashion designer, or what have you. In each case, certain game characters and tools will become more significant while others become less so. Regardless of the player's goals though, the roles of the NPCs and other artifacts rarely change in this game.

The New Super Mario Bros. as a Constructivist Learning Environment

Figure 4.21 The New Super Mario Bros.
source: IGN.com

The fundamental view behind constructivist learning environments is that technologies can and should be used to keep students active, constructive, collaborative, intentional, complex, contextual, conversational, and reflective. (Duffy, Lowyck, J., & Jonassen, 1993) To many, suggesting that most modern game environments are inherently constructivist learning environments will not come as a surprise. Still, it is one thing to say they are and another to show that they are through explicit connections. A brief explanation of each of the major elements of such an environment is offered in the next few paragraphs, followed by more detailed examination of one game as seen through this lens.

An ideal constructivist learning environment would give the learner a great deal of freedom to interact with it and still present the learner with interesting problems to solve and things to discover. Although *Mario* is an older style platform game played on a two dimensional plane, it still holds up well when scrutinized as a constructivist environment. In fact the dominant teaching mode, if we can even call it that is through trial and error or discovery learning. While it has already been admitted that *Mario* hardly qualifies as an educational experience, it is still an excellent example of a game that has remained popular for several decades. It is a game people of all ages willingly choose to play, while *Math Blaster* a well-known educational game that employs essentially the same style has only enjoyed popularity in schools. Given that contrast, an examination of the mechanisms employed in *Mario* might provide some hints as to what we should be including in our educational games to make them more engaging and effective.

Figure 4.22 Jonassen's Constructivist Learning Environments
source: K.Becker, original image: http://tiger.coe.missouri.edu/~jonassen/courses/CLE/
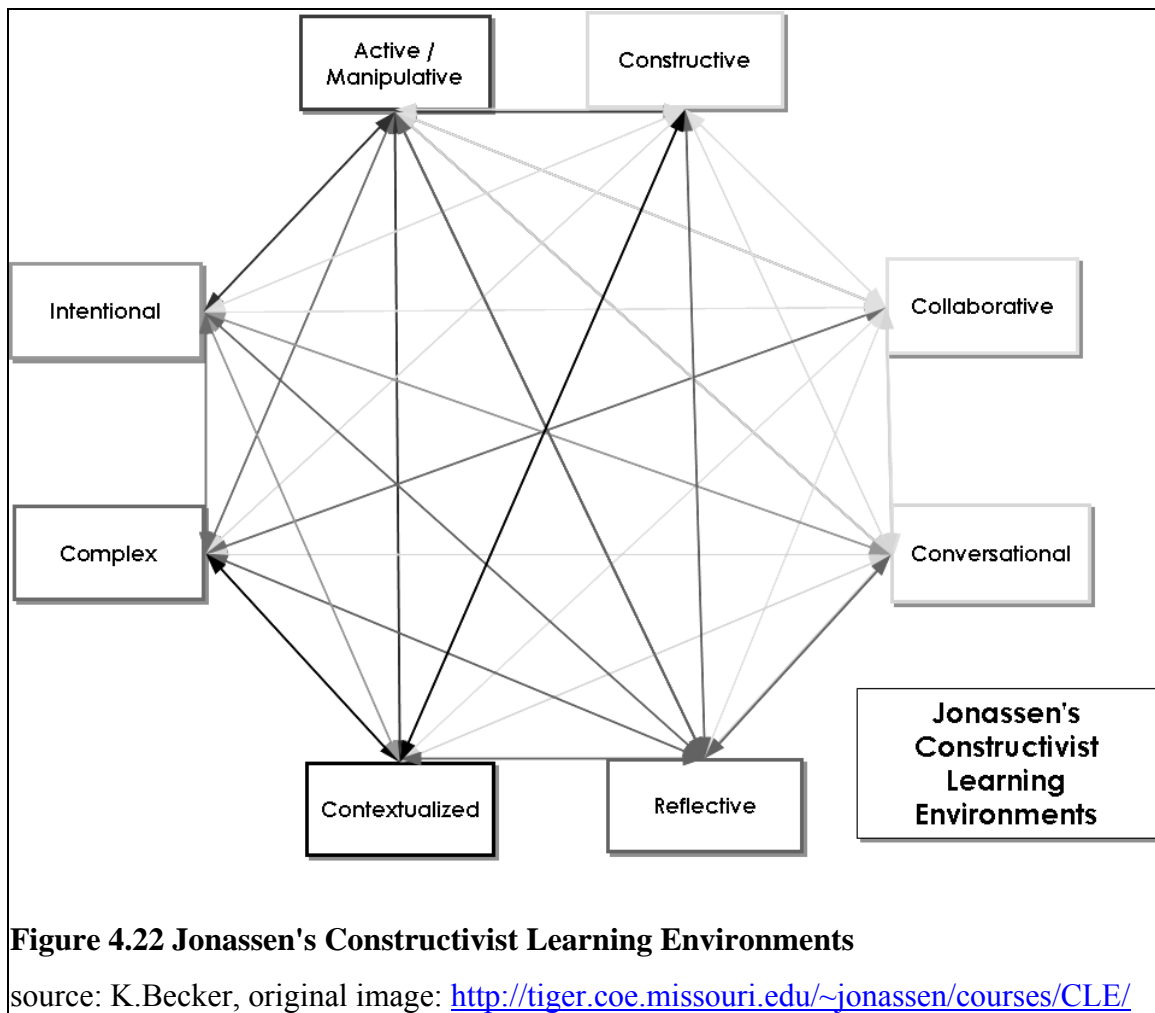
Active

"*Learners are engaged by the learning process in mindful processing of information where they are responsible for the result*" (Jonassen). This notion lies at the very heart of most digital games, and *Mario* is no exception. There are very few places in each level or course where the player can let Mario stand about and do nothing. This is often cited as one of the great attractions of this game: the game is fast-paced and players are always busy. Various villains are also present in each course and since they move around as well, Mario must be vigilant and ready to act. *Mario* has almost no dialogue beyond the occasional, "It's Mario!", "Bye-bye!", "Here we go!" and various

onomatopoeia, and the music is cartoon-like and up-beat, as is the imagery. Each level is associated with a specific 'world', and when the game begins we have access to only a single level on the first world. All other levels must be earned through our satisfactory performance. Success in this game is all up to us, and there is no way to get through the levels except by practice and more practice.

Constructive

"Learners integrate new ideas with prior knowledge in order to make sense or make meaning or reconcile a discrepancy, curiosity, or puzzlement" ([Jonassen](#)). The format of the game is essentially the same as a traditional obstacle course - there are a total of 80 different ones in eight different 'worlds', each of which has a different type of landscape - one is made up of deserts and another is entirely underwater. The courses in each world have a similar look and feel to each other with some differences as well and each one builds on some skills learned in a previous world while adding one or more new challenges. The first level introduces us to all the basic skills and 'power-ups': here we can and must learn to jump, run, and dash. We learn how to break blocks, catch star coins and we meet several of the 'classic' *Mario* bad guys: Koopas and Goombas. When viewed from a different perspective the game is constructive literally as well as conceptually in that we begin with access to a single level in a single world and we are given the impression that other levels are there but the pathways needed to reach them do not yet exit. Once we have successfully made it through to the end of the first course the next section of pathway is constructed and we gain access to the second course. Access proceeds in this way with more and more of *Mario*'s world becoming accessible as more

and more pathways are constructed. Once we have made it through the final course in the current world we gain access to the next world.

Collaborative

"Learners naturally work in learning and knowledge building communities, exploiting each others skills while providing social support and modeling and observing the contributions of each member. Humans naturally seek out others to help them to solve problems and perform tasks" ([Jonassen](#)). The current analysis only looks at the single player version of this game and since Mario acts alone and all of the NPC's are bad guys in this game there is little opportunity for collaboration within the game itself. Outside of the game, however there exists a thriving community of *Mario* fans eager to collaborate on anything from fan art and fan fiction to sharing tips, techniques and even videos of gameplay. Collaboration and the communities that sustain them are very strong with almost all popular and successful games.

A casual search on the web using the phrase "New Super Mario Bros." turned up 1,600,000 hits! Almost all of the first page of links (50) were sites offering reviews, previews, cheats, walkthroughs and hints, so there is clearly no shortage of players keen to share what they have learned and add to their knowledge with the help of others. One walkthrough guide is produced in full color and is 87 pages long ([Sallee, 2006](#))!

Intentional

"All human behavior is goal directed ([Schank, & Cleary, 1995](#)) That is, everything that we do is intended to fulfill some goal. When learners are actively and willfully trying to achieve a cognitive goal ([Scardamalia, & Bereiter, 1994](#)), they think

and learn more" (Jonassen). The motivational power of fun and humor should not be

undervalued (Dormann, & Biddle, 2006), and *Mario* lacks neither. The sights and sounds

are amusing and Mario's reactions are pleasing to the extent that repeating challenging

portions of a course over and over until we get it right sustains us. The response of the

game when we finally reach the end of a course is also appealing, and we are often

additionally rewarded with the release of additional courses. A game that has very little

point beyond entertainment MUST succeed here, or players will stop playing. Even

worse for the game makers, they will not encourage their friends to purchase the game.

Though the goals may be trivial, players will always be able to identify the goal they are

trying to fulfill at any given point in this game.

Complex

We need to engage students in solving complex and ill-structured problems as

well as simple problems (Jonassen). *Mario* is largely a game of skill and although there

are few complex intellectual conundrums, there is no shortage of complex puzzles. Here

is a brief description of how to proceed through a portion of the level five tower course:

> "Avoid the two Spiked balls that are rolling around here,
> getting the ? Block Power-Up, with the following ? Block
> set (the one on the right) holding a 1-Up Mushroom.
> Immediately after this portion get Mario towards the right
> side of the ledge as a Giant Spiked Ball will destroy the
> bricks on the left, signaling the point for Mario to start
> hopping up the ledges ahead, keeping himself above the
> nasty implement. Keep hopping upwards, fading to the
> right to get the third Star Coin on that side, followed by
> getting onto the ledges to leap upwards as soon as ledges
> appear because that Giant Spiked Ball will get back to the
> right side soon enough. Punch the bricks on the right to
> gain one last Power-Up, followed by passing through the
> large red doors to encounter the boss fight!" (Sulpher,
> 2006)

Mario presents players with challenge after challenge, some simple enough to meet on the first try and others complex enough to drive all but the most dedicated players to the game playing community for help and hints.

Contextual

Learning should be situated in some meaningful real-world or case- or problem-based task. Let's face it, *Mario* bears little resemblance to any real-world activity, but it certainly presents challenges. In fact, it is the contrived nature of the entire game that makes it an interesting design to study from an educational perspective. Although we are often told how important it is that the game's premise and story-line be fully integrated into the gameplay in order for the game to be 'good', *Mario*'s story is very weak and most of the activities we must master really have nothing to do with rescuing Princess Peach. *Mario* is a series of obstacle races so there really is no meaningful context to speak of. Yet, it still works and Mario remains one of the most popular and recognizable characters of all gamedom. Some of the reasons for this enduring popularity are probably similar to those that fuel the popularity of other cartoon characters like Mickey Mouse and Bugs Bunny, but part of it has to do with the integrated style of the *Mario* games: all have a similar look and feel; nothings seems out of place. This is where context plays an important role in an otherwise meaningless collection of silly activities.

Conversational

"Learning is inherently a social, dialogical process (Duffy & Cunningham, 1996). That is, given a problem or task, people naturally seek out opinions and ideas form others. Technologies can support this conversational process by connecting learners

across town or across the world" ([Jonassen](#)). Here again we turn to the wider game community because *Mario* is a single player game. Mention has already been made of the role played by the internet game communities while discussing collaboration, and it will be mentioned again in the next section, but one aspect that has not yet been included is that of other people likely to be in the same room as the player while they are playing. *Mario* can be a popular spectator sport. *Mario* also supports a two player mode which further encourages social interaction during play.

Reflective

"Learners should be required by technology-based learning to (articulate) what they are doing, the decisions they make, the strategies they use, and the answers that they found" ([Jonassen](#)). This is one place where many games are somewhat lacking in design ([Prensky, 2001a](#)). However, virtually all popular games spawn online fan communities whose main purpose is to allow players to share tips, knowledge, experiences, and artifacts that they have produced, such as fan art and fan fiction. If anything, in these venues popular games suffer from an overabundance of reflection. While they may not structured in ways educators find appealing, they certainly serve the same purpose, namely to reflect on the experiences of playing the game and discuss what they have learned.

Problem-Based Learning with Phoenix Wright

Figure 4.23 Phoenix Wright

Image source: IGN.com

Problem-based learning (PBL) is intended to build on the efficacy of experiential learning and promote learning through an investigation of a problem which learners must solve in groups or individually, in role-playing or scenario based contexts. Learning is student centered and relies upon self-directed learning (Savin-Baden, 2000). When designed as a formal exercise, PBL includes an introductory exploration of issues, followed by a development of the problem to be solved. It is usually assumed there will be a collaborative group of participants involved in the process who then hypothesize about possible solutions, gather information needed to resolve the problem and then present their solution when they are done.

1. Topic Introduction
Explore the issues.
What do we want to know?
What do we need to know?

2. Problem Statement
Develop, and write out, the problem statement in
your own words.

3. Hypothesize
List out possible solutions.
List actions to be taken
with a timeline.

**Problem
Based
Learning**

**4. Additional
Information**
What do we need to
know?

5. Data Requests
Include factual information, like: Policy
statements, Regulations Lists, records,
case histories, etc. Justify requests; Why is
this data important? How do you intend
to use the data?

6. Learning Issues
Address conceptual gaps
How to compute something.
Questions that can't be
answered by "looking it up."

7. Closure
Write up your solution with its
supporting documentation, and
submit it.
Review your performance.

Figure 4.24 Problem Based Learning

source: K.Becker, original source: Savin-Baden, M., 2000

The following paragraphs follow an analysis of *Phoenix Wright* from the perspective of a problem-based approach. Each of the five cases in this game can be viewed as a main problem, to which the PBL process can be applied. With each main problem there are also lesser problems and focusing this analysis on one of these provides a fairly complete picture of the process. It also helps to illustrate that the PBL process can be nested within itself in a procedural fashion: there can be one main problem which contains other problems, each one of which can be addressed using the same process.

The design of this game itself matches very closely with the formal PBL approach.

Topic Introduction

Explore the issues. What do we want to know? What do we need to know? Each case begins with a formal topic introduction. The fifth and final case is the most complex and twisted of all, which should not be especially surprising as we expect a progression of difficulty in almost any game we play. The synopsis of the case is as follows: the district chief prosecutor is accused of murdering a police detective in the underground parking lot of the prosecutor's office building. There is a witness (Angel Star, a former detective) and the chief prosecutor (Lana Skye) has confessed to the crime, but Lana's 16 year old sister is certain she didn't do it and asks Phoenix Wright to defend her big sister. Players already know that she must be proven innocent and the real murderer found because that is how this game is played. The cases, although they start off being relatively straight-forward quickly become quite convoluted.

The 'sub-problem' to be used as an example is one that occurs at the end of the first day of the trial (Chapter 1). This case is divided into six chapters which alternate between evidence gathering and in-court trial episodes. The game is organized such that when a new problem arises, the judge will call a recess and we are given an opportunity to gather more evidence and uncover more information. Once the information and evidence has been gathered, the player goes back into the courtroom. This change from one chapter to the next is controlled by the game, and players cannot choose to go back to a previous chapter once it has been passed.

Problem Statement

Develop and write out the problem statement in your own words. The specific problem to be examined occurs when during a witness testimony (that of Damon Gant, The Chief of Police) it is discovered that there had apparently been a second murder inside the Police Department on the same day and at the same time as the one incident of the current trial. The body was not found, and there are indications that a case that was resolved two years ago might somehow be linked to this one. Evidence from the two-year old case was found at the scene of the current crime but has not been shown to be linked to the current victim. The Chief of Police claims that there is no official link between the two murders that occurred on the same day. Through the evidence presented, it is possible to prove the connection between the two current murder cases, but there is still no second body. Further testimony and cross-examination shows that the murder victim in the second case appears to be the same person as the victim in the current case. The problem is now to clear up the mystery of how the victim could have been killed in two places at the same time.

Hypothesize

List possible solutions. List actions to be taken with a timeline. The next step in

the PBL process involves hypothesizing, and in the game this is accomplished by

dialogue exchanges between various characters at the start of the evidence gathering

chapter. Players have very little to do in this section except to scroll through and read the

dialogue. Through the given dialogue a brief review of what is known is presented,

players are told what we think has happened and they are also told what should be done

next in order to resolve the problem. In the story, two murders occurred at the same time

but there is only one body - this is not very likely. The accused (Lana Skye) will not

reveal anything - it is suspected that she is trying to protect someone or something. Given

the nature of this game, we (as players) can hypothesize that most of the information that

has been given to us is significant in some way, so it is reasonable to assume that the

references to the two-year old case are significant, and in case we didn't get this on our

own, we are given hints to that effect. The game essentially points players at the next

phase of the PBL process, namely identifying what additional information will be needed

in order to proceed.

Additional Information

What do we need to know? One of the game mechanisms added in this case is the

ability to examine evidence by rotating the image of the object along two different axes

as well as to zoom in and examine certain portions of the object more closely. In the

previous cases the only things players could do with evidence was to look at a picture of

the evidence and read a few details. If the evidence happened to be a piece of paper (note,

letter, autopsy report, etc.) they had the ability to read whatever excerpts the game designers decided to put in.

The evidence gathering portion of the game is facilitated through a small number of locations players can visit. Most cases have fewer than 10 different locations. At each place, players have at least two options: 'examine' or 'move'. The 'examine' mechanism was described in a previous section (Gagné's), so it will not be described again here, except to add that it is through this mechanism that players can find and collect evidence. The move option takes players from one location to another, but they can only move along certain pre-determined paths, so for example, if they wish to go from the Police Department to the High Prosecutor's Office, they must first go to the Underground Parking Lot, because the prosecutor's office is only accessible from there.

If players arrive at one of the locations and there is another character there, the game will provide two additional options: 'talk' and 'present'. These two options are the mechanisms by which data requirements and learning issues are fulfilled. Just as in other PBL exercises, it is not always easy to decide which one is a data requirement and which should be labeled a learning issue. In the game there is typically some initial dialogue followed by an opportunity to instigate further 'talks'. All 'talks' are necessary in this game, and sometimes additional ones will only become available after others are done - this is one way of keeping the player from seeing hints that they might not yet understand. The 'present' option allows players to show evidence to the character to see if it can provoke the character into providing more information. If the witness finds the evidence unmoving there is always the same response, but there is no penalty for trying.

Data Requirements (facts)

Include factual information, such as: Policy statements, Regulations, Lists, and records (weather data, enrollment data, official statistics, etc.), Case histories (student records, patient files, etc.). Justify requests. Why is this data important? How do you intend to use the data? Another way of looking at the distinction between data requirements and learning requirements is to say the one deals with 'what' while the other addresses 'how'. In the case of *'Rise from the Ashes'*, the data requirements will include the facts and clues of the case that we will need to gather in order to resolve the problem. In the course of gathering the needed data players also encounter learning issues, and vice versa, so it will rarely be possible to group items neatly into one or the other category. While they can be listed separately after the fact, since this example and analysis follows the process as it is unfolding, the remainder of the discussion follows under the next section.

Learning Issues (concepts)

Address conceptual gaps. How to compute something. Questions that can't be answered by "looking it up." In addition to concepts, learning issues include the 'how' that goes with the 'what'. So for example, in order to determine the facts of the two apparent murders, players will want to examine both murder scenes - if conflicting clues can be found, they can be pursued. At the start of the evidence gathering chapter, players find themselves talking to Ema Skye, the defendant's younger sister. She mentions something about blood stains, and presents a 'luminol kit' - a spray that creates a stain when mixed with blood - even trace amounts. One of the learning issues encountered is how to use this new device, and a short tutorial is given on the spot. Then, when this kit is used it is discovered that there are multiple blood stains at the scene of the 'mystery'

crime and only one at the scene of the current one. After various other talks and examinations, it becomes clear that the evidence suggests that there was only one murder and that somehow the body was moved from one location to the other, which in turn explains the missing body.

Closure

Write up your solution with its supporting documentation, and submit it. Eventually all the needed evidence is found and it is shown that the victim was actually murdered in the second location and then moved to the place where the body was eventually discovered. This includes the addition of yet another tool - a fingerprinting kit. This new tool takes advantage of the touch sensitive screen and built-in microphone of the DS, and allows players to choose a suspect print on some surface, dust it by touching the screen, and then literally blow away the excess dust revealing the print. As soon as this fingerprinting kit becomes available, the set of character profiles is altered to include their fingerprints so they can be compared against the records. The final step in this process is to suggest a match whereupon the game mimics a fingerprint matching program by focusing of several key points on the fingerprint for comparison. This tool illustrates an innovative use of the interface as well as adding a flavor of authenticity.

Ultimately, all the needed evidence is gathered and the witnesses can be pressed by asking further questions during the cross-examination of their testimony and by presenting the gathered evidence at the appropriate moments. Since this examination was of a sub-problem, the closure of this problem allows players to continue on to the next chapter, and ultimately prove the client's innocence. The format used in Phoenix Wright fits very cleanly with the PBL format, and even though this game is essentially a

branching story where players are led towards the end in a fairly lock-step fashion, the given interactive tools and the opportunity to 'solve the case' makes for a compelling and enjoyable experience. There is little doubt as to when a correct answer is found and player feedback is clear and immediate. The genre of the mystery is one that could be used in a great many learning situations, and this game provides a template for how to translate that into a game format, while still retaining the control that might be appropriate in certain learning situations where a 'right' answer must be the ultimate conclusion.

Discussion

Much work remains to be done before we can begin to understand the role of games for learning with the same confidence we currently enjoy for text-based and other learning technologies. That players are already learning a great deal through gameplay is clear. Whether or not we can leverage this learning to other objectives is less clear.

The connection of games to known and accepted pedagogy, like Gagne (1985), Reigeluth (1983), Bruner (1996), even Gardner (1983) ties what the literature says about games to some of what is formally accepted theory in education. This forms part of the necessary basic background work needed to establish games as instructional technology. Casual feedback from teachers has indicated that this explicit connection is vital to helping educators see the potential educational applications of games in formal learning contexts. Many would now agree that games teach. The literature is replete with claims that games do one or another thing well (Gee 2003, Prensky 2001a), and many use examples from a wide range of games. What has been largely lacking from the literature is to explicitly and systematically connect the dots between what is being said about the

advantages of games and what instructional technologists are saying is necessary for effective instruction. Specific games have typically been mentioned because of their utility in illustrating a point, but without justifying the choice of game based on any kind of independent assessment.

The basic argument made in this chapter is that if these are the things that are considered necessary for effective instruction, and it can be shown that games have these things (sort of a proof by construction), then I can claim that games have the potential to embody effective instruction (sort of proof by induction). The argument is a conjecture and not a formal proof; while formal mathematical proofs are appropriate for some applications in science they are generally speaking not appropriate in social contexts.

CHAPTER 5. MINUTE PARTICULARS: METHODOLOGY OF RANKING AND

CHOOSING GAMES FOR STUDY

> He who would do good to another must do it in Minute
> Particulars. General Good is the plea of the scoundrel,
> hypocrite, and flatterer. *- William Blake (1757-1827)*
> *Jerusalem*

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Introduction

Before a researcher can perform studies using commercial games, whether they be

studies involving people or studies of the games themselves, they must choose which

game or games to study. In some situations the game forms part of the case or cases being

studied, as in Kurt Squire's study of learners using *Civilization III* (Squire, 2003) and in

other situations the game is itself the case, as in Oliver and Pelletier's Study of *Deus Ex*

as a model for looking at how people learn in games (Oliver & Pelletier, 2005). Either

way the choice of game deserves explanation.

Why is it important to justify the choice of game being used as an example in a

scholarly article or for the purposes of study? In the early days of games studies there

seemed little call for careful scrutiny of one's game choices. We studied what we had

handy and wrote about the games we were already playing. However, if we want to make

the case that the game in question is good by some measure (however we decide to define

"good") then we really should have some evidence to back this up. When a single game or a small number of games are chosen as the subject(s) of study they form part of the bounded system that is the case being examined, and also forms part of what makes the case of special interest (Stake, 1995). If we are proposing the use of a game in the classroom or the study of some specific game to learn something applicable to our agenda, then as academics we have a responsibility to explain why that game is suitable for our purpose.

One reason for putting thoughtful effort into justifying the choice of a game used in a study is that it helps to make the study itself more credible. This has implications for the increased acceptance of game studies academically as well as for helping to improve relations between academia and the games industry. In a recent article offering suggestions for how the Academy could build stronger ties with the Games Industry, John Hopson argues that we should

> "(u)se examples from bestsellers. A good example from a popular game is more effective than a great example from something they've never heard of. Industry people often suffer from an 'if-they're-so-smart-, why-ain't-they-rich' attitude towards smaller titles. Even if the small title is a perfect example of how the theory works, they're going to be less likely to listen if they haven't heard of the game ahead of time. Commercial success is one way of making sure that the audience will respect your examples, but you can also use titles that are well known or critically acclaimed but which weren't necessarily huge blockbusters. It's also important to keep your examples as current as possible, because many industry folks will see a three-year-old example as ancient history" (Hopson, 2006).

Critical and commercial success are key recognizable and accepted (albeit subjective) measures of a game's popularity, and that popularity in turn gives some

indication of that game's perceived quality as judged by players, developers, and game

critics. When it comes to resources that are primarily creative or artistic in nature,

subjective measures are often the only ones we have. In sports for example, such as

sprinting, determining who the fastest sprinter is can be done quite objectively – it is a

matter of comparing competition times and the runner with the fastest time wins but no

such objective measure exists for most creative endeavors, and since games are creative

designs we can only produce subjective measures. To further compound the problem,

lists of 'top games' tend to be quite unstable and change not only from year to year as

new titles gain recognition, but sometimes from day to day as in review sites where

players can contribute. One consequence of this is that no single list can reasonably be

used to support claims about a particular game's qualities. One solution is to combine

multiple lists into one comprehensive one. By combining multiple lists, we can increase

our confidence in the qualifications of games that end up on top. However, the challenge

in combining measures from these various sources is that the criteria used to produce lists

of 'good' games are often so divergent that they cannot be compared or combined

directly. Categories and scores vary, the methodology used to rate and rank the games

varies, even the contributors vary – in some cases they are paid professional critics, in

other cases association members or even the public at large contributes votes and

reviews. The data fusion technique described in this chapter offers a solution to this

problem that is both verifiable, and repeatable. Combining a number of different

measures to come up with a single measure ensures that games that end up at the top of

the final list qualify as successful by more than one measure and have been assessed by

more than one source. Using a systematic approach to ranking games results in a list with which most (industry, gamers, and critics) could agree.

Why Do We Study Games?

Game Studies continues to develop as a discipline just as digital games continue to evolve. While there remains an interest in examinations of specific games for various purposes, as the number and sophistication of titles released in a given year continues to rise, it is time to begin looking more closely at how we are choosing the games we study, the criteria we use for those studies, and how we support our claims about the suitability of the game for our purposes. Although commercial success as demonstrated by sales figures is an important measure of success, it is not the only one, and may not be the most important one for any particular study. Often, studies of individual games are conducted with the hopes of being able to generalize at least some of the conclusions to other games and/or other players. Given the number and variety of games with no cleanly defined delineations of genre, can it be assumed that it is possible to examine one game and make generalizations to other games? How should these generalizations be qualified or limited? Games are no longer trivial, nor frivolous so this is not a straightforward question. There were approximately 2500 game titles released in 2005 [22] (see Table 5.1). With so many titles released in one year it becomes harder and harder to justify choosing a game based on personal preferences. Claims that a particular game meets certain criteria critical to the analysis should be supported by something beyond the author's say-so. There will have to be some way of providing evidence supporting the claims we make about the qualities of

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[22] In the summer of 2007 gamestats.com states that it has over 48,000 games covered in its website.

the game that we have determined are necessary to our study. As studies on, with, and of games become more accepted and common in mainstream educational research, it will also become more important to justify the choices of subjects. This has not been common practice to date.

Table 5.1 Annual Title Releases								
by Platform(IGN.com, collected on Dec. 6 2006)								
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
Total Games	1033	1395	1308	1659	1841	1949	2082	2420
PC	453	547	533	589	680	601	484	827
Macintosh	36	62	55	94	102	93	60	62
PlayStation	222	269	145	77	59	21	2	
PlayStation 2	45	174	258	251	262	274	258	
PlayStation 3								24
Portable PlayStation							77	166
Xbox			40	176	230	229	239	117
Xbox 360							44	120
Dreamcast	54	152	72	3	1	1	1	
Nintendo	64	95	69	15	1			
Wii								77
GameCube			21	157	157	116	111	47
GameBoy	122	210	228	277	177	177	176	140
Nintendo DS						12	85	144
Wireless			5	108	289	368	340	
N-Gage				15	20	25	5	
Other	51	41	25	22	61	128	136	93
Note: these numbers are included as evidence that there are now large numbers of games released and that as a result, it is no longer sufficient to choose a game for a study without addressing the question, "Why was THIS game chosen?" in a more formal, scholarly fashion than has been practiced to date.								

How Do Researchers Choose Games For Study? (A meta-analysis)

Since the question of how games are selected by researchers has not previously been examined the author conducted a qualitative meta-analysis (Delgado-Rodríguez,

2001) of what methods researchers reported using in choosing games for study. According to Delgado-Rodriguez, meta-analysis has the following meaning:

"The prefix "meta" means behind or beyond, of a higher or second order kind. It can be defined as a systematic identification, appraisal, synthesis, and, if relevant, statistical aggregation of all relevant prior studies on a specified topic according to a predetermined and explicit method. "

In this study it was the method used to choose a game (or games) and the justification for that choice that was the focus of analysis. The meta-analysis included 52 papers that were examined in detail (for a list of the papers used in the study, see Appendix C - Papers Considered). Papers and reports published primarily between 2003 and 2006 were examined with the goal of determining the reporting frequency of explanations of game subject choices. While it was not known if selection criteria were applied to the choices of games that did not get reported in the studies, it was *not* the goal of this analysis to offer a critique of the choices themselves, simply to examine how they were made. Note that a lack of explanation in the publication does not prove a lack of consideration for the study. It is certainly possible that carefully considered reasons motivated the game choices in many of the studies presented here, but that these were simply not included in the publication. The worthiness of the choice that was made is also not being examined here, and indeed many well-known game scholars are included in the list of papers examined. In many cases there would be little controversy over the claim that the chosen game has the specified characteristics. In some cases there would also be no dispute that the particular type of game is a suitable choice (and perhaps even the most

suitable choice) for the study as reported (see Table 5.2). Many of the reports have

contributed to the body of knowledge in games studies in important and significant ways.

Table 5.2 Role of game(s) in study or report				
	Study Type	**Study Focus**	**%**	**count**
1	General	any game or all games (the study looks at the game rather than people using the game)	19%	10/52
2	Typical	a certain kind of game rather than people using the game	40%	21/52
3	Apparatus	people using the game, or some other aspect where the game is the tool	33%	17/52
4	Example	more general discussion or study which uses a game as evidence, or to illustrate a point	4%	2/52
5	Mod	the mod or embellishment of an existing game	4%	2/52

A distinction was made in the meta-analysis between the description of the game

(including gameplay and any noteworthy features of the game) and a rationale for the

choice of the game. Virtually all papers examined offer a description of the game(s) used.

Fewer (37%) explained why this game meets the need of the study, and fewer still (15%)

supported that explanation with citations (see Table 5.3). It is suspected that many game

choices were, at least in part opportunistic, as the researchers had access to or were

already playing this game. Only one researcher actually stated that they were already

playing the game as their explanation for choosing it (Chen, 2005). In three other cases,

the researcher states that they have prior experience with the game but it is not made clear

whether the study began before or after that individual began to play that game, nor how

much influence the author's own game playing preferences had on the choice (Bos, 2001;

Klastrup, 2003; Martin, 2005). Comments such as, "I've been playing this game for

years" places game studies in a somewhat unique position as both casual and avid gamers

draw on their own playing experiences to help inform their studies. This kind of

connection places many game studies in the realm of what Glesne has called "Backyard Research" which can make separating researcher roles from pre-existing ones complicated and difficult (Glesne, 1999).

Table 5.3 Rationale given for the choice of that (those) particular game(s)		
Rationale	**Count**	**Percent of Total**
already familiar with it	2	4%
interesting	1	2%
large	2	4%
meets requirements of study	19	37%
popularity	8	15%
prior work	2	4%
successful game	2	4%
to play w/ students	1	2%
tried other approach (which failed)	1	2%
variety	2	4%
violence	2	4%
no reason given	10	19%
Note that explanations of how the stated requirements support the study were rarely included. For example, popularity is given as a rationale in 8 reports, but they do not explain how the game's popularity is important to the study. Obvious rationales such as "we needed an MMO" still beg the question, "Why **THAT** MMO?"		

The field of game studies is still in the process of building academic credibility, and generalizability of studies is one issue that can be addressed by more rigorous justification of game choices. In a longitudinal study of violence in an online videogame, Williams and Skorik raised questions about the generalizability of games which have implications far beyond their own study. "The online database www.allgame.com lists descriptions of more than 38,000 different games across 100 platforms. To collapse this wide variety of content into a variable labeled 'game play' is the equivalent of assuming that all television, radio, or motion picture use is the same" (Williams & Skoric, 2005). As Dill and Dill have noted, "This is akin to lumping films like *The Little Mermaid* with

Pulp Fiction, and expecting this combined 'movie viewing' variable to predict increases in aggressive behavior" ([1998, p. 423](#)). One interpretation of this statement is that we are not currently paying sufficient attention to the great variety of games available. Such a large number of games means that we cannot assume that one game is as suitable as any other for the purposes of study (i.e. we cannot collapse all adventure games into one category for the purposes of study). Studying ONE game does not necessarily allow us to generalize our findings. While a suggestion to force all games researchers to use some sort of 'scientific' approach to choosing games is clearly unreasonable, paying closer attention to how we choose games can certainly help address legitimate questions about a game's fitness for purpose in the context of a study. It may not be necessary to explain why someone has chosen Shakespeare or Chaucer to study, but games have not yet attained the level of acceptance that classic literature has and we should still be explaining our decisions. If we choose a game because it is one we personally like, that may be justified, but we still need to address how that makes that game a worthy candidate for study. If we choose a game because it is popular, then we should be able to support that with facts or citations that can stand up to scrutiny.

Towards A Solution

The meta-analysis conducted by the author included 52 papers that were examined in detail (for a list of the papers used in the study, see [Appendix C- Papers Considered](#)). 91 games were identified comprising 71 distinct titles (some studies used more than one game but numerous studies used the same games such as *[World of Warcraft](#)*). Only one paper out of 52 examined reported having applied some systematic technique to identifying games for study. 19% offered no explanation for why they chose

the game they did. Several offered the explanation that they were already playing it. In most cases claims that the game met the criteria described were not supported (89% of those who claimed the game met their stated criteria did not support that claim with any further references). Only one study described a rationale for the exclusion of one or more games from study (Warnes, 2005) and one other report explained the methodology used to select the game for the study - Henderson (2005) allowed the study participants to vote on a game, citing prior research that suggested participant interest was an important factor in the study's success. The results of the meta-analysis indicate that a very small minority of game researchers currently report on the methodology used for the choice of a game in a study, or use examples of excluded games to support their choices. Very few explain how or why their stated game requirements support the goal of the study. While some cite references to support at least some of their claims about why this kind of game is needed for this study, almost none cite any references supporting their claim that the chosen game actually meets those requirements. By far the most common attribute supported by other references is the claim about the game's popularity and the most common outside reference is to sales figures.

Table 5.4 Analysis results						
	yes (>1)	yes	partial (only for some)	no	no access to full paper	n/a
Does report have references to support claims about validity of rationale for game choice. (i.e. the qualities necessary for a suitable game for this study)?	1	15% 6/41	1	80% 33/41 confidence interval = 12	1	19% 10/52
Does report have references to	0	4%	10% 5/49	86% 42/49	1	4%

support for claims that chosen game meets specified criteria?		2/49		confidence interval = 8.5		2/52
Was there any mention of games not chosen or description of unsuitable games?	-	2% 1/52	-	98% 51/52 confidence interval = 3.7	-	-
Was there any mention of any structured methodology for the game choice?	-	2% 1/52	-	98% 51/52 confidence interval = 3.7	-	-
Note the confidence interval is calculated for a 95% confidence level, a population of 1000, and a sample size as stated above. Population size is estimated but has a small effect on confidence intervals.						

Fitness for purpose "equates quality with the fulfillment of a specification or stated outcomes" (Harvey, 2004). If a researcher claims that a particular game is an appropriate choice for a particular study it is also appropriate to offer justification for the claim. Given the great number of games available, it is no longer sufficient to claim that a particular game meets certain criteria without supporting that claim in a verifiable way. Even though critical and commercial success are both recognizable and accepted measures of a game's popularity, and popularity in turn gives some indication of that game's perceived quality as judged by players, developers, and game critics, these are also highly subjective measures. Combining a number of different measures to come up with a single measure ensures that games that end up at the top of the final list qualify as successful by more than one measure and have been assessed by more than one source. In the case of this dissertation the games examined are intended to representative 'masterpieces' so there must be some way to convincingly determine that the games from which the final choices are made are of a stature that would qualify these games in that category.

Defining Success

When seeking a quantifiable measure of success, two perspectives come to mind: critical and commercial. Critical success is typically thought to include acclaim by professional critics which can also include winning various recognized awards. Critical success can come from many sources, and three different kinds are included in the approach described here: the game developers themselves, the buying public, and the critics. There are many examples in literature, film and other media of works that have achieved critical acclaim but not commercial success and vice versa. Both are measures of success and with modern acceptance of player-reviews as one form of acclaim, both should be included in a list that claims to include 'good; or 'best' games. Commercial success does not always imply quality (we all know of films, for example that were a commercial success but which appeared to have few redeeming qualities), but it is an indicator of popularity and with thousands of titles released each year, and nearly 230 million games were sold in the US in 2005 (ESA, 2006) inclusion in the top ten or twenty games in any given year is a significant achievement. That means that less than 1% (possibly less than .05%) of these games makes it onto this best seller's list.

Combining Data

There is evidence to suggest that word of mouth, game demos, and reviews are all important factors influencing a decision to purchase a game (Dobson, 2006), but there is also evidence to suggest that review scores do not significantly affect game sales (Boyer, 2006). One possible consequence of this is that since there is no statistically significant relationship between sales and reviews, both values should be included in the selection process as neither one provides a complete picture alone. As already stated, we also know

from literature, theater, and film, that popularity as evidenced through sales does not always match critical acclaim, yet both tell us something about that work's quality. The sources of the values used to compile various lists are important and some effort should be made to identify the primary data sources whenever possible. For example all of the sales data the authors were able to find could be traced back to a single source: the NPD statistics. This means that there is no point in combining sales lists from multiple sources since they in turn all got their data from the same source – it simply amounts to counting the same data multiple times. This phenomenon should also be remembered when combining other data from multiple sources – we need to check where they got their data from.

A very small minority of game researchers currently report on the methodology used for the choice of a game in a study, or use examples of excluded games to support their choices. Very few explain how or why their stated game requirements support the goal of the study. While some cite references to support at least some of their claims about why this kind of game is needed for this study, almost none cite any references supporting their claim that the chosen game actually meets those requirements. By far the most common attribute supported by other references is the claim about the game's popularity.

Selecting Games for the Current Study

The preceding meta-analysis indicates quite clearly that little attention is currently being paid to justifying the choice of game for a study, but the sheer number of titles available implies that some justification is required. The goal of the game selection process in this study was to choose five representative examples of 'good' games that

have received both critical and commercial success. Clearly, 'good' is a highly subjective designation, so the more reviews and ratings that could be combined, the more confident one could be in the final list. However, there are no standards for game reviews or best-of lists so a major hurdle was in finding a way to combine lists from multiple sources in a verifiable and repeatable manner. To address this gap, a new methodology based on data fusion for generating a ranked list of games was created and used in the selection of games for this study.

Data Fusion Methodologies

Data fusion is the process of pulling together information from various sources to create a single composite representation. It has its roots in artificial intelligence and has been used to combine sensor data for various purposes. It has also been used in image analysis (Parker, 2001). There are many approaches to combining data in data fusion, and the one that was applied to the problem at hand uses Borda counts. This method was felt to be most appropriate as it is relatively straight-forward and allows multiple ranked lists to be combined. For a more detailed discussion of voting methods, please see the section on data fusion in Becker & Parker (2008). A brief explanation of the particular approach that was chosen, namely Borda Counts follows.

Borda Counts

The Borda count is an election vote counting process developed about two centuries ago (Borda, 1781) that can be employed in situations where candidates are ranked in order of preference from most to least desirable. It can be used to determine a

single winner, but in this case it is being used to generate a single objective [23] ranking

from a set of many lists. These include ranked lists of many games as well as individual

game ratings. There are three categories of list (discussed below in the section on Data

Sources), each of which results in a ranked list. The final lists were then be combined to

form a single ranked list. In a Borda count, each element is assigned a point value that

corresponds to its relative position in a ranked list. So in a list of five items where first

place is considered the best and the fifth place is considered the least desirable of the five,

the first may be assigned a point value of 5 and the last may be assigned a value of 1. In

human candidate voting, it is common to assign points based on the number of candidates

ranked lower the one being examined, which means that the highest value here would be

a four and the last place candidate would get no points. The principles of Borda counts

can be applied as long as a consistent assignment of points is used, as is the case here.

When the voting is complete there will be one ranked list from each voter, and we then

combine these to sum the point values of each 'candidate'. In a single winner contest, the

one with the greatest number of points wins. In a contest where relative ranking is

desired, it allows multiple lists to be combined into one.

For example:

Suppose we have 4 lists of five 'candidates' ranked as in Table 5.5. The point

values associated with each rank are applied as in Table 5.6. Then, the sums for each

candidate are as shown in Table 5.7.

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[23] Objective from the perspective of how the various lists are combined. The original lists are often
subjective.

Table 5.5 Borda Count Example 1				
	List 1	List 2	List 3	List 4
FAVORITE	K	M	B	A
SECOND	M	B	K	M
THIRD	B	K	J	K
FOURTH	J	J	M	B
LAST	A	A	A	J

Table 5.6 Borda Count Example 2				
	List 1	List 2	List 3	List 4
FAVORITE	K=+4	M=+4	B=+4	A=+4
SECOND	M=+3	B=+3	K=+3	K=+3
THIRD	B=+2	K=+2	J=+2	M=+2
FOURTH	J=+1	J=+1	M=+1	J=+1
LAST	A=+0	A=+0	A=+0	B=+0

Table 5.7 Borda Count Example 3				
	List 1	List 2	List 3	List 4	sum
K	K=+4	K=+2	K=+3	K=+3	12
M	M=+3	M=+4	M=+1	M=+2	10
B	B=+2	B=+3	B=+4	B=+0	9
J	J=+1	J=+1	J=+2	J=+1	5
A	A=+0	A=+0	A=+0	A=+4	4

In this case there are no ties, but ties are possible. For the purposes of this study the prospect of ties is not an issue – if the games are ranked as equivalent, then it doesn't matter which is chosen.

Measures of Commercial Success

For this study, commercial success is defined by sales and measured as units sold in a given year in the US. There is only one source for this data: NPD Funworld® http://www.npd.com/, which is the source used by the ESA (Entertainment Software Association), and most other press agencies. NPD Funworld® is the primary source of video game sales and consumer information.

While it is acknowledged that commercial success is no assurance of quality, inclusion in the top ten or twenty games in any given year is a significant achievement. There are thousands of titles released each year, and nearly 230 million games were sold in the US in 2005 (ESA, 2006).

Measures of Critical Success

Critical success can come from many sources, and three different kinds are being used here. One is the game developers who actually design and build the games, and that voice is heard through the two professional organizations named below (AIAS and IDGA). These groups hold annual award events similar to the Academy of Motion Picture Arts and Sciences' Oscars. Another source is the gamer-reviewer: someone who does not work for a games company or press agency but plays the games and is willing to contribute publicly available reviews of individual games. The third is the press. There are now a great many websites and magazines devoted to gaming and most contain review sections. Most will publish gamer reviews along side those written by paid correspondents. The sources named below (Table 5.8) include well-known sites that do not have any allegiance to a specific platform or publisher.

Table 5.8 Sources of Measures of Success
Professional Industry Organizations
AIAS - Academy of Interactive Arts and Sciences IGDA – International Game Developers Association
Press and Gamer review sites:
GameSpot.com Metacritics.com IGN.com (Independent Game Network) MobyGames.com GameCritics.com

There is evidence to suggest that word of mouth, game demos, and reviews are all important factors influencing a decision to purchase a game (Dobson, 2006), but there is also evidence to suggest that review scores do not affect game sales (Boyer, 2006). One

possible consequence of this is that since there is no statistically significant relationship

between sales and reviews, both values should be included in the selection process.

Data Sources

When all the sources of data are considered, there were essentially three

categories of list, each of which resulted in its own ranked list of games. These were then

combined to produce a single consolidated list from which a final 'short' list was

generated.

The three major categories of game lists were:

1. Sales Rank (there is only one source: NPD – ESA, AIAS and others use it.) These
   are ranked lists. This is usually a top 10 or top 20 list, produced annually. Titles
   are typically separated by whether or not the game was developed for a console or
   computer.

2. Best of All Time lists: Many review sites have one of these and they already
   combine assessments from various sources through various mechanisms. These
   are all ranked lists. Review scores usually present a value out of 5; 10; or 100 and
   only those produced by official reviewer sites will be used (i.e. individual user
   reviews won't be used here, although collective ones will). Sites such as
   Metacritics.com use review scores from many professional media critics and
   combine them using weighted scores into an overall average score.

3. Best of the Year list – lists included in this category typically list a number of
   games that have been ranked. These are either presented as ranked lists or as a
   single winner with one or more runners up. This kind of ranking system (with
   unranked runners up) has broad acceptance in the entertainment industry (eg.
   Academy Awards) and so would normally be accepted. For this study, the runners
   up are all classified as being in second place. This category also includes some

individual categories or contests – these are usually single winner announcements, such as some Best of E3.

Games were ranked separately in each category, and then combined using a modified Borda count ([Borda, 1781](#)) to produce a single list. The traditional Borda Count method was modified as follows. For each list, each 'win' was allotted a percentage score based on the number of games in the category such that a first place game was allotted 1 point, the 5th place out of five would get 0.2 points, and the 'last' place game out of 100 would get only 0.01 points. This way no single game can accumulate more than one point from any given list, meaning it must appear on multiple lists in order to remain near the top. Unlike typical Borda counts, the last place game is also given a value due to the fact that there are many more games 'below' it that are not included in the list. The more lists a game appears on, the higher its score is likely to get. However, if it is always a runner up it will accumulate fewer points than if it is a winner. A game that wins in its genre in a Game of The Year contest will get 1 point towards its accumulated score. However, if it also won Best Console Game of the Year then it will accumulate an additional point.

These calculated scores were then added together to form a single list used to rank the games. The final list contained 1670 entries totaling 780 distinct games, and the top 100 games were selected for the 'final rounds'. It was important to include all games from all categories in the initial voting because the points allotted to a game depend on the number of games in that list. If MMOs, sports games and M-rated games were deleted too soon, the voting would have bcome skewed. To illustrate, suppose this is one of the lists: *Madden NFL 2006* is 1st, *Halo* is second, and *Black and White* is third. If this list is left as is, then Black and White gets 1/3 of a point added to its accumulating score for

being in third place because two other games beat it. If the sports game and the M-game are removed then Black and White will get a whole point. This could end up changing the order of the games quite a bit - leaving me with a different "Top 100" list.

Once the 100 top ranked games had been selected, those that needed to be excluded were removed. This left a list of 54 games in 12 categories. There was at least one game in each category already in my possession, so these became the 'short list'. This left 23 games to consider, all 23 of which were games that could be classified as among the best games available. Given that the 'short' list was known to contain games that were highly rated both critically and commercially, I was free to choose games that I had at least some personal interest in playing – games are designed on the assumption that players are already somewhat motivated so this is a reasonable approach. It is also more difficult to stick with a game one does not like (although it might be useful to look at one just to see if I can still see how it is teaching). The data collection and analysis of ranking is done to verify that the games I have chosen are also rated "good" by people other than me. While I recognize that the word "good" in this context may continue to be somewhat problematic, the same can be said of any other subjective label, like 'sound' or 'appropriate'. In this context, 'good' means 'critically acclaimed', popular, and commercially successful, in other words, fit for the purpose I propose.

The Game Selection Process

In light of the fact that the work herein was intended to bear relevance to future developments in the instructional design of games to teach, some general criteria for choosing some kinds of games and excluding others were set out. There were:

- choose from a variety of genres

- exclude MMOs, sports games and M-rated games

The reasons for choosing and excluding various games are outlined in more detail below.

Since there can be no truly objective method for choosing games likely to yield insights and results as required by this study, every attempt was made to ensure that the final list from which games were chosen included those titles that a substantial number of gamers and industry professionals would agree were games worthy of study.

This study has no previous studies that can be used as guides for its analysis of learning structures in videogames, and games have rarely been examined in this manner so there was a possibility that one or more of the selected games would fail to yield useful results. If after some analysis it appeared that one of the selected games was unlikely to yield the necessary results, another game on the list was used instead. Games that were rejected in this manner are discussed in Chapter 7 (Results).

Choose games from different genres for variety of experience.

It is likely that there will be many similarities among games of the same genre, especially First Person Shooters (FPS) and racing games. This must be true or it would not be possible to classify games by genre at all. This similarity is likely to be evident in both learning how to play the game and the gameplay itself. For example, in many if not most role playing games activity centers around one major and many minor quests. In the course of the quests, items must be found, won, stolen, or otherwise acquired that will in turn need to be used to accomplish other tasks and defeat other adversaries. The 'high-level' mechanisms that make this possible are similar across most role-playing games.

'Health' is a common measure used to determine the abilities of a player's avatar at any given point in the game. If health is high, stronger adversaries can be challenged, but if it is low then the player must do something else to rebuild her health first. While it can be illuminating to analyse the mechanisms involved in supporting this sort of gameplay, most role playing games will have similar mechanisms. Thus, examining games from various genres is likely to generate richer results than would be possible if only one type of game were used.

First person shooters and racing games display this 'similarity' property to a greater extent than do role-playing games, action games and action adventure games. On some level all racing games are similar. It is one of the qualities that makes them popular. People know what to expect from this genre, just as people know what to expect from a romantic comedy movie – the details will differ, but most romantic comedies have the same basic story line: girl meets boy (or vice versa); they don't like each other; then they become attracted to each other but don't acknowledge it; then they do; something gets in the way of the relationship; they overcome the obstacles and live happily ever after. This is not necessarily bad, merely predictable.

There are almost certainly differences between different games of the same genre – just as if all romantic comedies were too much the same then people would have little interest in seeing the next new one. However, this study is the first of its kind as far as is known and studying a variety of genres is more likely to generate the richest variety of results. Subsequent and follow-up studies could and should focus more precisely on specific types of games and even specific sequences. An example of such a study might be, "How do role playing games help players learn how to manage their avatar's health

status during a game?" Other studies could compare bestselling and poorly selling or best and worst rated games of the same genre. It is even conceivable that a correlation will be found between "teaching success" and player reviews (although perhaps not sales), but this is beyond the scope of this study and must be left for future studies.

Exclude MMOs (massively multiplayer online games), and sports games

In the case of MMOs, since they are expressly designed to be played with many players en masse, it is difficult if not impossible to definitively differentiate between learning that occurs because of the game design and that which occurs because of the other player support. Further, many of these games are difficult if not impossible to play without the help of other players (Sirlin, 2006). Player to player interaction and communication aside however, the gameplay aspects of these games tend to be similar to those of the other games in similar genres. Indeed, the unique aspect of multi-player games is precisely the interaction between players, which is not the subject of this study.

Sports games were also excluded because when considering sports games, especially team sports, most video games assume a prior knowledge of the sport being portrayed. As a result it is unclear what kind of learning beyond practice is taking place. Further, it is impossible to identify how much of the popularity of such games is due to the popularity of the sport being portrayed, and how much is due to the game design. Some specific sports may be somewhat different, such as skateboarding, but many of those share elements with racing games, so like the MMOs, they lack sufficient distinguishing features to qualify them for this study.

<u>Choose from games rated 'T' for teens or 'E' for everybody.</u>

'M' rated games tend to include considerable mature themes, and have no place in most educational K-12 situations. Issues surrounding sex, violence, and other mature themes in games are also not within the scope of this study and will be avoided. As a result only games rated 'E' for everyone and 'T' for teen will be considered for study.

Finally, the games that are chosen must be games I can acquire. The reason should be obvious: there is no way to assess a game that I cannot have in my possession. Further, it must be playable on one of the modern consoles available to me. Just as books can go out of print, so can games and the equipment needed to play them. For example, although *Golden Eye 007* is in the top 20 of the final list, it must be excluded because it was built for the Nintendo 64 console which is no longer readily available [24].

The "Finalists" and the "Winners"

The following lists represent the final selection procedure which resulted in three lists: the first list simply represents the top games from the list of 100. The 'accumulated score' is the sum of all the adjusted Borda count values from the original lists, and the 'frequency' is a count of the number of times that game appeared on one of the original lists. These games are listed in alphabetical order, by genre then numerically by score. The second list ('first cut') represents the games to be examined, and the final list was created as back-up in case the games from the initial list proved unsuitable, which several ultimately did. For a more detailed illustration of the list generation process, see

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[24] except on ebay

Appendix D - Choosing Games For Study, and for a discussion of which games were

ultimately rejected and why, see Chapter 7.

Game (finalists)

\	Table 5.9 - Game Choices(finalists)	\	\	\	\
ID	Game	Accumulated score	ESRB	Genre	Frequency
3	Black & White	11.08	T	Real Time Strategy	13
11	Shadow of the Colossus	8.42	T	Action Adventure	11
13	Metroid Prime	8.03	T	Fighting	10
18	Soul Calibur II	6.67	T	Fighting	7
20	Legend of Zelda: Wind Waker	6.32	E	Action Adventure	9
26	Final Fantasy VII	5.32	T	RPG	8
33	Grim Fandango	4.84	T	Adventure	7
34	Animal Crossing	4.82	E	RPG	6
35	Sims 2	4.80	T	Sim	7
40	Elder Scrolls IV: Oblivion	4.34	T	RPG	6
48	Katamari Damacy	3.98	E	MISC	6
65	Psychonauts	3.00	T	MISC	3
72	Sid Meier's Civilization III	2.90	E	Strategy	4
92	Pikmin	2.25	E	Adventure	3

Table 5.9 is a list of the games that remained of the 'Top 100 list' after the

elimination criteria were applied. In other words, the remaining games are rated "e" or

'T', have single-player modes, are not sports games, and are games to which I have

access.

Table 5.10 represents the 5 choices to examine along with five runners-up that

could be used if the first five failed to yield usable results.

Table 5.10 - Game Choices(first & second choices)

Game (first cut)	Game (second look, runners up)
Grim Fandango (Adv., PC)	Shadow of the Colossus (AA, console)
Katamari Damacy (misc, console)	Pikmin (RTS, console)
Animal Crossing (RPG, console)	Elder Scrolls IV: Oblivion, The (RPG, PC)
Black & White (RTS, PC)	Sims 2 (SIM, PC)
Metroid Prime (FPS, console)	Soul Calibur II (Fighting, console)

Application

The approach used here was intended to generate a short list of games that could be considered 'good' by what amounts to a 'common vote'. In other words various reviewers, developers, and players consider these games to be among the best. While this may help to justify their inclusion for study, this still does not ensure that they will yield any useful results when analyzed as learning objects. Chapter Seven discusses the games that were finally used in the study and why some of the games proved ultimately unsuitable. The next chapter contains a description of a new methodology, developed specifically to allow analysis of games as learning objects, called Instructional Ethology, which also has potential applications to a much broader set of inquiries.

CHAPTER 6 THE MISSING LINK: INSTRUCTIONAL ETHOLOGY,

METHODOLOGY FOR ANALYZING LEARNING SUPPORT IN GAMES

> I have found the missing link between the higher ape and
> civilized man: It is we. *- Konrad Lorenz*

Note: Parts of this chapter have been previously published and is based on an earlier work: Katrin Becker, **Instructional Ethology: Reverse Engineering for Serious Design of Educational Games**, presented at Futureplay 2007, Toronto, Canada, November 15-17, 2007 Posted by permission of the publisher. "© ACM, (2007). FuturePlay Proceedings"

Figure 6.1 Animal Crossing Wild World

(source: Katrin Becker)

Does a crisis exist in formal education? Is it time for educational researchers to embark on 'revolutionary science'? Though the question of whether or not game-based learning is a 'science' is an open one, a brief look at how revolutionary science can advance has some relevance to the current question. As a discipline, the field of game-based learning is essentially still in what Thomas Kuhn described as the pre-paradigm phase which is characterized by multiple incompatible and incomplete theories (Kuhn, 1962). There is as yet no consensus on any particular theory about how games work and how to use them, and plenty of room for new ideas, theories and viewpoints before we can start being critical and eliminating things. Effective application and use of games and game technology for education requires examinations of existing artifacts, both in and out of formal educational settings, as well as the development of

new theories and models for how to design games intended primarily to educate rather than entertain.

Chapter 4 connected the dots between recognized pedagogy and existing commercial games and provided evidence to support the notion that at least some digital games made primarily for entertainment already incorporate the major components necessary to meet the requirements of sound instructional design. Since this incorporation has not been a deliberate game design decision, it is unlikely that designers such as Sid Meier or Sir Peter Molyneux would have included "implement Gagne's nine events of instruction" (Gagne, 1985) as part of their design specifications when creating *Civilization III* or *Black and White*. Because this actualization was spontaneous, interviewing or otherwise studying the games designers themselves is unlikely to generate results in a form that can be applied to instructional design. However, uncovering the mechanisms that support learning in digital games can be approached from a different angle.

Most commercial games do not lend themselves especially well to analysis as educational learning objects because they were never designed as such. This study will analyze the game itself rather than the effect it has on the learners. Analyzing an entertainment game as though it were an educational one when it was not designed as such necessitates a dissociation of what is learned in the game from how society values that which is learned. Doing so creates a common plane on which both educational and entertainment games can be assessed. A lot of what we say hinges on the notion that were are talking about the "good" games, as opposed to all games. So, how do we find those? The solution presented here ended up having to look to Data Fusion techniques. This

subject is discussed in detail in Chapter 5 with an approach that allows for the games

chosen for study to meet the criteria as specified according to a rigorous, verifiable

methodology.

In the next section the methodology employed to examine games is that of

Instructional Ethology. This is a new approach based in part on reverse engineering and

in other part on behavioural studies in biology. Neither approach has been used in this

context before. Normally, reverse engineering attempts to recover the original design of a

software application, but in this case it is used to generate an *alternate* design that can

then in turn be used to inform instructional design. The other significant element in this

new method draws its inspiration from the study of animal behaviour: Ethology. Through

this perspective, it is possible to identify learning support mechanisms used in successful

games and from there to associate these mechanisms and strategies with the learning

objectives they can support. These strategies can then be used in educational games

without compromising the essential qualities that have made digital games the most

popular leisure activity in the western world today (Roberts, Foehr & Rideout, 2005).

Instructional design for games is a young but growing field. Other reports have

proposed instructional design theories and models for educational digital games (Dickey

2005, Gee 2003, Paras & Bizzochi 2005, Rieber & Matzko 2001, Van Eck 2008). As was

outlined in Chapter Three Sandford et al conducted a study using COTS games that found

that teacher expperience played an important role in the effective use of games (Sandford,

Ulicsak, Facer, & Rudd, 2006), and de Freitas (2007) found that K-12 schools were using

more games than post-secondary institutions. Most games that have been examined in

this context have either been educational games or commercial games being used in

educational contexts. In addition, most studies involve the use of games in formal

learning situations like classrooms and the subjects of the study are the learners. It

appears that educational software still has a long way to go. David Buckingham, in his

2004 conference address said that "edutainment is a strategy that is doomed to fail. Most

so-called educational software is visually impoverished, it's lacking in interactivity, it's

thin on engaging content" ([2004b](#)).

On studying behaviour

One way to facilitate an understanding of how a new medium like digital game

technology can be used effectively in education is to study the designs of that medium's

outstanding examples, regardless of their original purpose. In other words, it is possible

to uncover instructional design elements by studying the game itself and its behaviour.

The goal of Instructional Ethology is to do just that.

Commercial games have not typically been considered to be educational objects.

For one thing, they were not designed with education in mind - in fact, until recently (in

games like *Brain Age*), the suggestion that a commercial game could be an educational

one was often met with denial from the game designers as 'educational games' are seen as

intrinsically inferior to entertainment games in the industry (which is kind of ironic, as

exactly the opposite has been true in Education). Because of this, and the fact that most

game designers are not formally trained in education and therefor unfamiliar with the

approaches to discourse and design in that field, it is unlikely that examining game design

documents or interviewing the game designers will provide us with information in a form

we can apply to instructional design.

The methodology described in the following sections is a new approach which analyzes the game itself rather than the effect it has on the learners or players, but does so as if that game actually *were* an educational object. In other words the analysis assumes that the software is deliberately designed to help people learn various things. However, R.S. Peters, in Criteria of Education ([1966](#)) states that it is impossible to consider education without implying some worthwhile and desirable change in the person being educated. Thus, analyzing an entertainment game as though it were an educational one when it was not designed as such necessitates a dissociation of what is learned in the game from how society values that which is learned. Doing so creates a common plane on which both educational and entertainment games can be assessed. For example, most people would likely agree that *The New Super Mario Bros.* really has *no* educational value - it doesn't teach much of anything that we, as a society might value. BUT it is an example of a game that does a good job of helping people learn the things they need to learn in order to win, however goofy we may think those things are. In other words, if teaching is seen as the facilitation of learning, then it does a good job of teaching, even though what is learned may have little educational value. As of proof of concept, two games were examined and compared: *The New Super Mario Bros.* and *MathBlaster* ([Becker 2007b](#)). Both games are the same genre - 2D platform games; they are both essentially obstacle courses where what needs to be done doesn't necessarily have any sensible relation to the storyline or the stated goal, yet *Mario* did a far superior job of helping its players reach the goal than *MathBlaster* did - and - *MathBlaster* would have the potential to be a more successful game (i.e. provide better learning support) if it employed some of the strategies that *Mario* used.

A game's behaviour, like that of any other software application can be observed. The primary facet of the game that is observed through this perspective is its external behaviour as seen through its interface. The study of digital games has not really been approached from this angle before, and studying the game *behaviour* is synonymous with studying the software that implements the game. Studying software behaviour is neither new, nor controversial - we've pretty much been doing it since Ada Byron, Countess of Lovelace talked about the first program she designed for Babbage's Difference Engine around 1850. Computer scientists have always had an interest in the way a program behaves once it is running. Often the motivation for such study is to improve the program's performance in one way or another (fewer page faults, less memory usage, fewer calls, faster throughput, etc.), other times it is to enhance, augment, or otherwise alter the user interface (HCI – Human-Computer Interface). The field of computer science involved in such analysis is typically software engineering and the process employs a form of reverse engineering. What is new in this research is the study of the behaviour of a game in order to identify how it 'helps' people learn.

The described method for analysis of a commercial game is based on three fundamental assumptions:

1. Players must learn and indeed **do** learn new things while playing the game.

2. Successful games are successful at least partially because they facilitate that learning.

3. It is possible to examine learning in a digital game without associating what is learned with value-laden educational aims.

All three are necessary conditions that make instructional ethology an appropriate methodology in this context.

A comprehensive analysis of a game's behaviour involves a two-pronged approach:

1. An anatomical analysis of the game's structure, which can be accomplished through ontological excavation (i.e. using the morphology to uncover the game concepts and relationships). This generates an essentially static model of the game's anatomy.

2. An ethological analysis of the game's behaviour, which uses methodology adapted from the study of animal behaviour. This part results in a description of the more dynamic aspects of the game.

Both facets are outlined in the following sections, and the latter approach (instructional ethology) is discussed in detail, with analytical results presented in the next chapter (Chapter 7).

Reverse Engineering and Ontological Excavation

<u>Black Box Reverse Engineering</u>

Figure 6.2 General Model for Software Re-Engineering.

Image source: <u>Byrne, E. J. (1992), p.230</u>
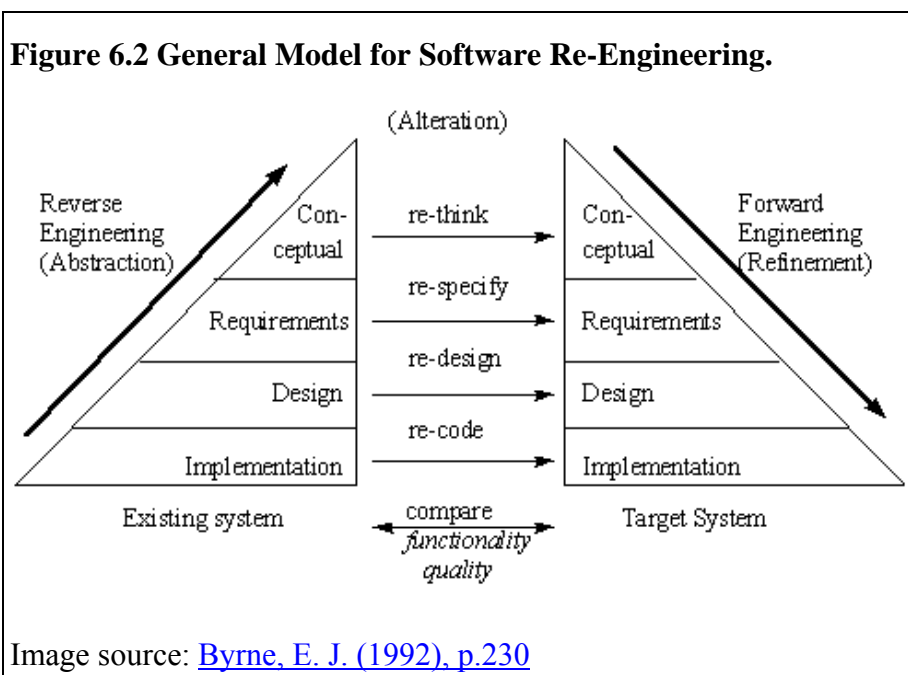
The anatomical analysis portion of instructional ethology uses a variation on black box reverse engineering as used in software engineering, but it is an approach that has not been used in this context before. Reverse engineering is the process of analysing a software program or application in order to discover how it works, and is referred to as 'black-box' if the process does not examine the original source code of the application. Normally, reverse engineering is performed in order to recover the original design of a software application for the purposes of renovation or augmentation (<u>Chikofsky & Cross, 1990</u>), but in this case it is used to generate an alternate, hypothetical design that can then in turn be used to inform instructional design of serious games. This alternate design is one that may not have been explicitly formulated by the original designers. It focuses on the instructional aspects of the program's behaviour as observed through its interface – hence the term 'ethology'.

Ontological Excavation

The described methodology is specifically though loosely based on a technique called 'ontological excavation', developed by Idris Hsi (2005). This is a technique for reverse engineering that uses the morphology, or external interface of an application to uncover the ontology of an application, or the application's "theory of the world". For example, a calendar application's ontology would embody a theory about how users schedule their time.

Figure 6.3 Onotological Excavation Process
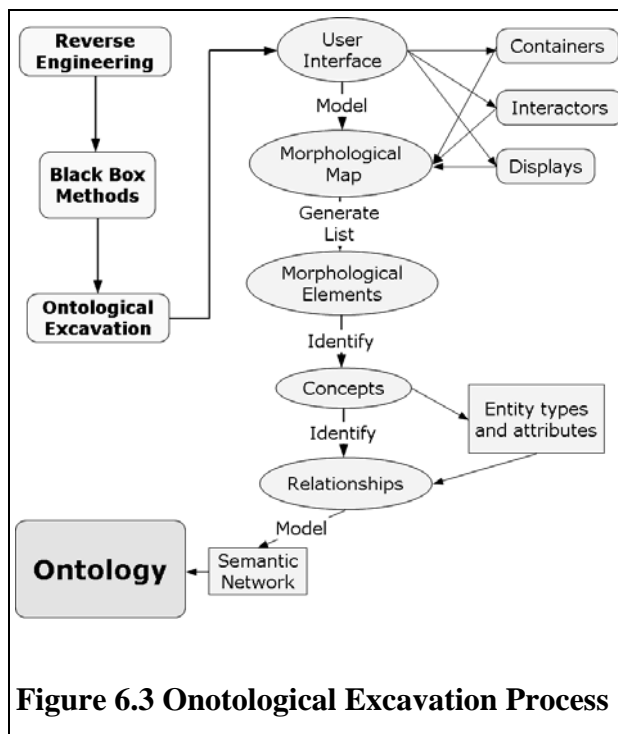
Ontological excavation is based on the notion that informed decisions about how best to modify an existing application cannot be made without examining what that application 'knows' or 'understands' about its domain. This domain is said to exist if there are comprehensive relationships among the items of information including a store of knowledge that can be used towards solving its problems, and a community of stakeholders. The methodology described by Hsi (2003) analyzes the application's 'theory of the world' and can identify potential inconsistencies that occur, either in the existing application, or in proposed modifications.

There are five main steps to this process (Hsi, 2003), which are also illustrated in Figure 6.3:

1. Model the user interface in a morphological map of the application's

    o   interactors (buttons, text fields, check boxes)

    o   displays (pop-ups, messages)

    o   containers (windows, dialog boxes, toolbars)

2. Generate a list of morphological elements from the map. For a CD Player application, for example, these may include such things as 'Volume Control', 'Track Number', and 'File Name'

3. For each element, identify the concepts (entity types and attributes) that it invokes. Some of these come directly from the previous step, and others are implied by the elements identified, such as 'File', and 'Track' in the CD player example.

4. Through dynamic interaction with the application, identify the relationships between the concepts. This is then turned into a list of adjacent elements from the maps created. In Hsi's methodology, these first four steps are accomplished largely through 'brute force' by hand.

5. Model the concepts and relationships (from the list produced in the previous step) into a semantic network representing the application's ontology. This allows for an analysis of the centralities of the various nodes (eigenvector and betweenness are used), and will make outliers and clusters obvious, as well as identify key relationships.

Game Ontology

Figure 6.4 Onotological Excavation Process of a Game
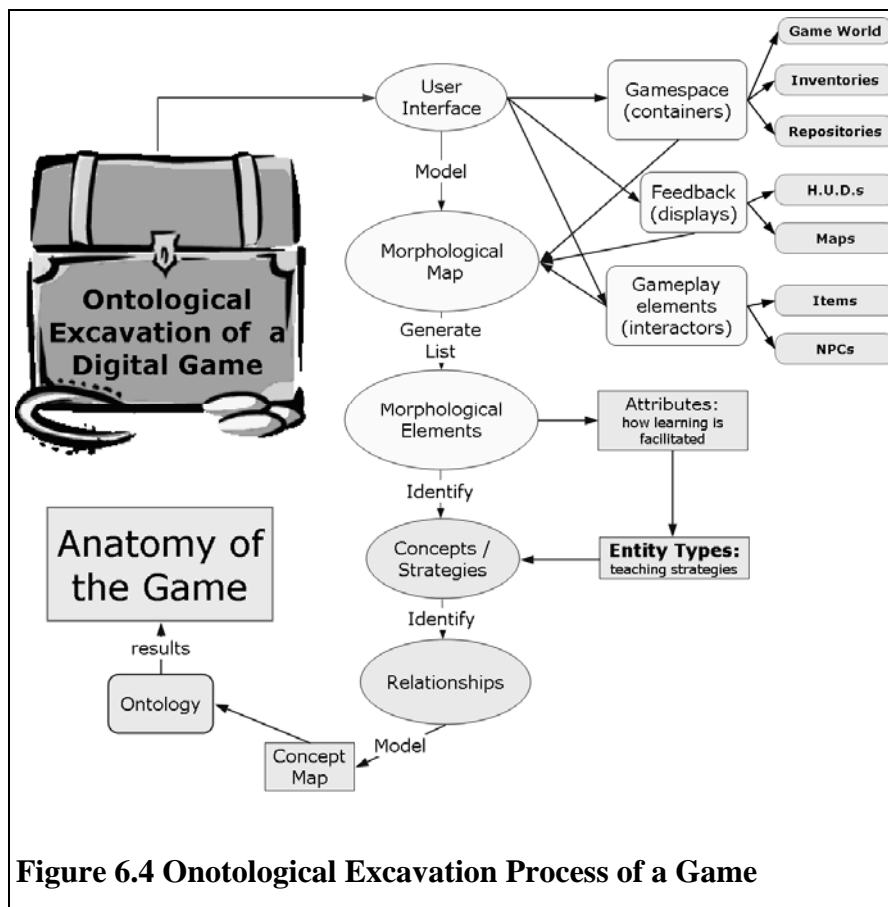
Since the object of the analysis in the current research is to yield instructional elements of the application rather than its original ontology the process has been adapted. Further, since a comprehensive excavation is both time consuming and very complex and the main focus for this work was on the ethological portions, a structural analysis was not executed in detail for the games examined.

However, when this notion of ontological excavation is applied to a game, a comparable theory seeks to address how the designers intended players to take up the game and would include how players are helped to learn what they need to learn in order to win the game. Also in the case of a game, because there is likely no access to the game's source code this ontology is inferred solely from its morphology. This is accomplished by examining the game as it is being played which differs significantly

from other studies of learning in games in that this analysis focuses on the game and not the player. While there are numerous sophisticated utilities and meta-languages for the description of ontological computer data models, most are designed to support code development from an object-oriented perspective, whereas instructional ethology examines the learning elements of the application which do not necessarily bear any relationship to the structure of the underlying code so these utilities are not useful here.

To use this approach to help uncover learning elements, the process is modified in the following way. The first few steps remain essentially the same, but the kinds of elements and how they are classified are changed. Since the object of this analysis is to yield instructional elements of the application rather than its original 'commercial' ontology the process has been adapted.

1. Model the user interface in a morphological map of the application's

   o   interactors (items, NPCs)

   o   displays (maps, H.U.D.s)

   o   containers (the game world, inventories, item repositories)

2. Generate a list of morphological elements from those items in the first step that yielded nouns. These first two steps proceed much like in the original process.

3. For each element, identify the concepts (entity types and attributes) that it invokes. In this case the attributes will be how, if at all, this element facilitates learning (such as colour differences between instances), and the entity types emerge from classifying the attributes. These may be listed as strategies, like provide hint, tell answer, etc.

4. Through dynamic interaction with the game, identify the relationships between the concepts/strategies. This step will link those elements that facilitate learning in connected ways.

5. Model the concepts and relationships into a concept map or connected graph representing the game's instructional anatomy.

There is likely to be some overlap between elements uncovered through anatomical analysis and those uncovered through ethological analysis. It is not yet known whether, and in what ways, these elements differ from the others.

Ethology
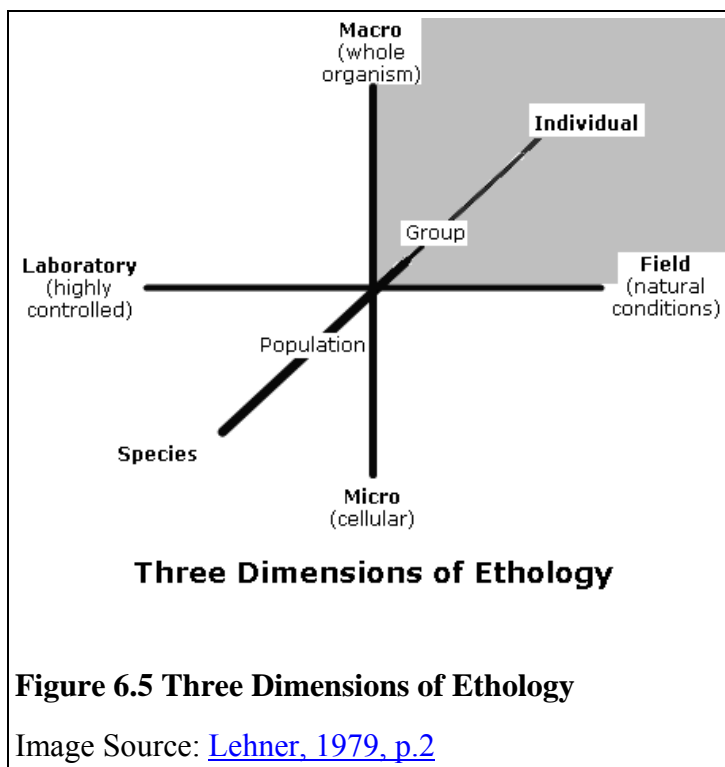
Ethology is the study of animal behaviour, and is traditionally defined along three dimensions (Lehner, 1979). The level of observational detail ranges from macro, which looks at whole organisms to micro, which goes down to the cellular level. The conditions under which observations are

Figure 6.5 Three Dimensions of Ethology
Image Source: Lehner, 1979, p.2

made range from highly controlled laboratory ones to uncontrolled natural field situations. The number of individuals included for observation can range from a single individual to an entire species or even family or order. Each could be assigned a

counterpart in the study of digital games, but for the purposes of this research, only the top right quadrant, as seen in Figure 6.5 is of interest. This research examines whole, individual games under essentially 'natural' conditions [25]. As will be seen, the analogy does have limitations, but can be pursued far enough to allow for the development of a methodology for studying games that retains enough aspects of the original to still be called 'ethology'.

The Four Questions

The following section provides an outline of the basic approach to the study of animal behaviour and the role of simple observation, followed by an explanation of how the methodology has been adapted to apply to digital games.

In 1963, biologist Nikolaas Tinbergen published a seminal paper (1963) outlining four fundamental questions of animal behaviour which have become the cornerstones of animal behaviour research. These cornerstones are: causation, function (survival value), development (ontogeny) and evolution. While acknowledging the value of analytical and experimental approaches in his discussion of the historical development of the discipline, he cautioned against placing too much emphasis on purely analytical and experimental approaches while neglecting basic observation and description. The methodology described here pays tribute to this position.

> "Description is never, can never be, random; it is in fact
> highly selective, and selection is made with reference to the
> problems, hypotheses and methods the investigator has in
> mind. In the early days of Ethology these limitations of our
> descriptions were not always obvious - mainly, I believe,

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[25] Though it could be argued that 'natural' is not a term that can be applied to a digital artifact, it is used to distinguish between ordinary use and targeted experimentation.

because most of us were not sufficiently conscious of our limited aims, and certainly were not sufficiently aware of the criteria we used for selection" (Tinbergen, 1963, p. 412).

His point was that even though we know that description is almost always biased, we still do not have sufficiently explicit formulations of the problems to be studied to warrant increased selectivity. In other words we still need more descriptive data to understand and explain the work being done. The same could be said of game studies, in this case, especially when it comes to understanding how games can be used as educational media. Later, on the same page he says:

"However, if we overdo this in itself justifiable tendency of making description subject to our analytical aims, we may well fall into the trap some branches of Psychology have fallen into, and fail to describe any behaviour that seems 'trivial' to us; we might forget that naive, unsophisticated, or intuitively guided observation may open our eyes to new problems. Contempt for simple observation is a lethal trait in any science, and certainly in a science as young as ours" (Tinbergen, 1963, p. 412).

Both of the preceding quotes apply well to game studies - and also to any notions of studying program behaviour from new perspectives. The methodology proposed here involves what amounts to 'simple observation' of the behaviour of a game and Tinbergen's four fundamental questions form the basis for the study of instructional ethology. The purpose of this approach is to discover what mechanisms help support the learning that must occur in order for players to reach the end. To help introduce this new approach, a brief definition is provided for each question, followed in the next section by a more involved treatment.

The first of Tinbergen's questions addresses **causation**. The original question is: ***What are the stimuli that elicit the response, and how has it been modified by recent learning?*** In animal studies, this question addresses both internal causal factors like instinct and hormones and external ones like hearing a howl or catching prey. For a game the question becomes one of interaction: **What player or other actions elicit the response, and how is it modified by changes in input?**

The second deals with **function**: ***How does the behaviour impact on the animal's chances of survival and reproduction?*** In game terms this element is the heart of how games 'teach' and corresponds to learning support: supporting the player while they play through the game ensures the 'survival' of that instance of the game. The question, then, is: **How does the behaviour of the game help it to 'succeed' in the goal of helping players get through to the end?** It is the only one of the four not likely to be described in a gamed design document.

The third question asks about **development**: ***How does the behaviour change with age, and what early experiences are necessary for the behaviour to be shown?*** A game's behaviour can be said to develop as well but we usually call it game flow, so the question can be adapted to ask, **How does the game's behaviour change as players advance (as from level to level), and what criteria are necessary for that behaviour to be modified?**

Finally, the fourth question which speaks to **evolutionary history** asks, ***How does the behaviour compare with similar behaviour in related species, and how might it have arisen through the process of phylogeny?*** Obviously, games are not bound by any kind of genetic relationships, or by true evolution, but they are still categorized by genre,

which of course has its roots in taxonomy. While novel approaches to known genres are possible as well as the combination of several genres embodied in a single game, the metaphor is still useful as most games can be classified by their primary form, such as a shooter, or a puzzle game. Thus the final question for instructional ethology is one of classification: **How does the game's behaviour compare with other games in the same genre and how is it related to other genres?**

To help make the distinctions between the domains of these questions clearer, consider the following example using a common human behaviour. Why do we shake hands when greeting another person? One answer could be the simple visual stimulus of seeing the other person's out-stretched hand, or, if you happen to be the instigator of the exchange, it could be hearing the phrase, "I'd like you to meet….". Both of these explanations have to do with external ***proximal causation***. Another explanation might be that brief physical contact releases the tension caused by meeting someone not known to you. That is internal causation. A ***functional*** reason could be that you've been told you can assess aspects of a person's personality by their handshake and are looking for a new job, so you want to impress them. Yet a third answer is that you have been taught to shake hands by your mother, or perhaps you have found that not doing so causes you to feel awkward - these would be a ***developmental*** explanations. Finally, a different but equally valid reason is that during Roman times, offering an exposed right hand proved that you were not wielding your weapon and allowed for peaceful exchanges, and over time this display became a symbolic gesture of greeting. This last one is an ***evolutionary*** answer. All four types of answer are correct, but each reflects a different level of inquiry.

These guiding questions, in their game adapted versions form the basis of the behavioural analysis which is the framework through which the interactive parts of the game are analyzed, and the structural analysis roughly follows the process described for ontological excavation.

Instructional Ethology

As described above, ethology is the study of animal behaviour through the lens of Tinbergen's Four Questions (Tinbergen, 1963). Each question has an analogy that can be applied to a digital game, and indeed to the study of the behaviour of any software application. These four questions address four types of problem:

1. Interaction (proximate causation, or control) How does it work?

2. Function / Purpose (survival value) What is it for?

3. Game Ontogeny (development, externally driven behaviours - game flow, or in the more general case: program flow) How did/does it develop?

4. Classification (evolution; phylogeny) How did it evolve?

These are the four fundamental questions form the basis for the study of instructional ethology. The following paragraphs highlight some of the contents of Tinbergen's original paper in the context of instructional ethology. Although this paper is now 40 years old, it is still particularly relevant because studies of strictly behavioural analysis have declined, so there has been relatively little new development of methodology. Thus, the 'old' discussion is also the current one.

According to Tinbergen, one of Konrad Lorenz's great contributions to ethology is that "he made us look at behaviour through the eyes of biologists" (Tinbergen, 1963, p.

411). This approach is distinguished from a psychological approach in that the starting point is inductive where description of observable phenomena is required. Psychologists typically ask, "How?" and when applied to analysing software, this same question is addressed through reverse engineering techniques. The biologist's approach seeks to answer, "Why?" and includes the three major questions of biology: causation, survival value, and evolution, as well as the fourth which was added by Tinbergen: ontogeny.

The main questions as well as the approach is useful in Instructional Ethology (IE), but it must be remembered that we are dealing with a program made up of algorithms and digital assets. The metaphor can only be applied so far. It is the methodology that is of interest - not what we have learned about animal behaviour. This is **not** about anthropomorphizing a computer program. It is about looking at program behaviour from a new perspective that gives us fresh questions that can be applied to generate new insights.

> "Much of the early ethological work contained a good deal of description and, in these first days of reconnaissance, of taking stock, we tended to think of 'ethograms' as hundred-page papers which could contain about all we wanted to know about a species "(Tinbergen, 1963, p. 412).

It could be said that we are in the reconnaissance days of instructional design for games too, and the notion of an "ethogram" may be of value in IE[26]). Tinbergen goes on to speak about a move into analytical approaches rather than simple observation, and he warns that abandoning simple observation has a danger of missing important elements of behaviour.

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[26] although I'm not sure the length would be appreciated (!)
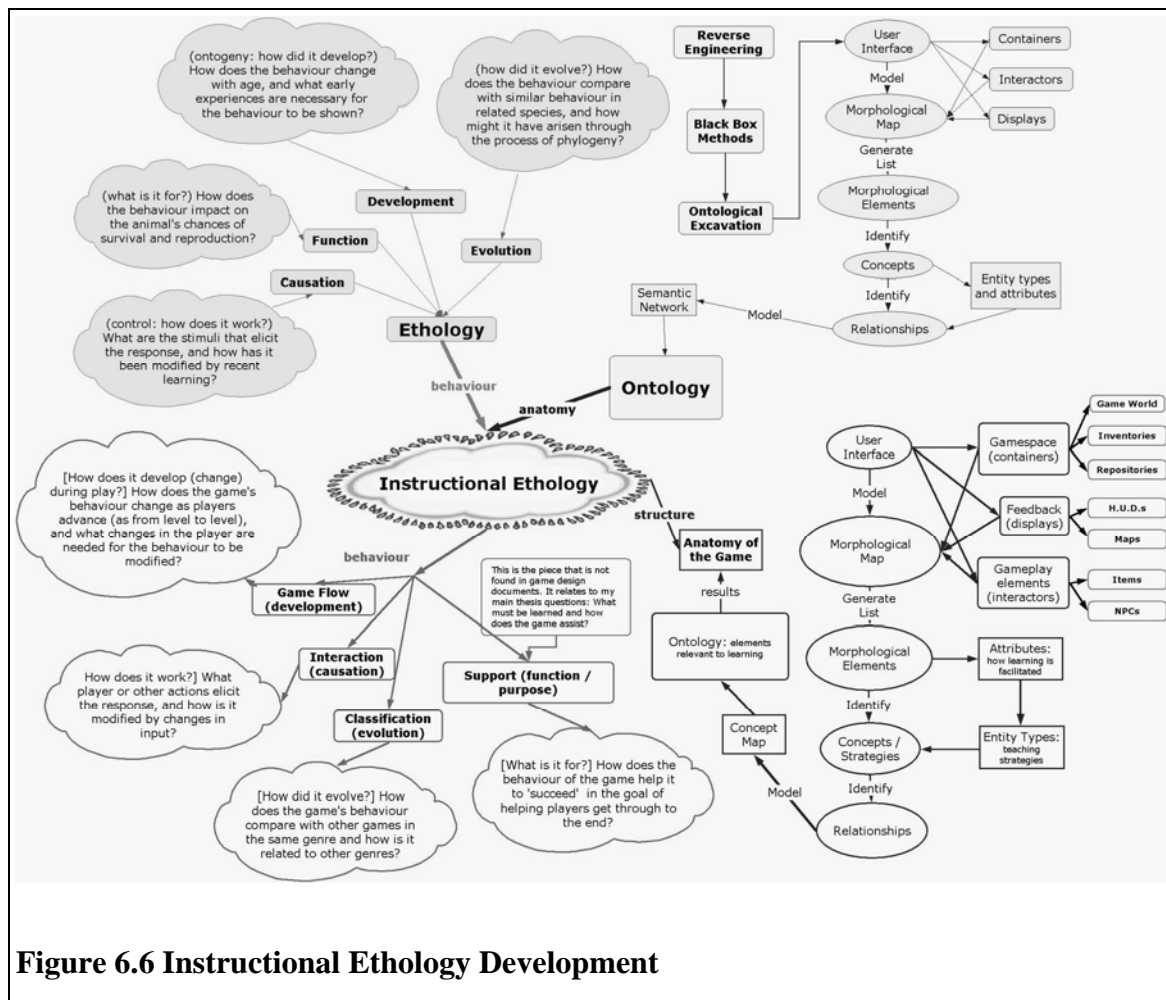
Figure 6.6 Instructional Ethology Development

Lorenz said that "animals can be said to 'possess' behaviour characteristics just as they can 'possess' certain structural and physiological characteristics" (Tinbergen, 1963, p. 413). Digital games can similarly be claimed to "possess" certain characteristics, but these are, at least for the most part, deliberately designed. An exception to the deliberate design is emergent behaviour - things that the game can be made to do that were not intended by (and may surprise) the designers. These behaviours, although not intentional in the original design may still have value when it comes to informing design and are fair game as far as behavioural studies go. Researchers in Animal Ethology seek to understand not only the causes of behaviours, but also the purpose they serve and the

same questions apply to both intentionally designed and emergent behaviours in Instructional Ethology.

"It is, of course, in itself completely unimportant whether or not one calls a certain types of work by a special name, as long as one agrees it has a place in the progress of science, but the issue has important implications. I believe that it is doing our science a great deal of harm to impose boundaries between it and Physiology where there are none, or rather where there is only a 'cline' from behaviour analysis on the one extreme to 'Molecular Biology' on the other. I believe that the only criterion by which these extremes can be distinguished is that of integration of the phenomena studied. For an understanding of our aims it seems to me much more important to recognize that fundamental identity of aims and method unites all fields. It is the nature of the question asked that matters in this context, and this is the same throughout. Co-operation between all these workers is within reach, and the main obstacle seems to be lack of appreciation of the fact there is a common aim" (Tinbergen, 1963, p. 415-416).

Here we have a lovely explanation of why an insistence on slotting things in one or another category, as is done in Educational Technology when games are categorized as separate from simulations, is neither unique, nor ultimately helpful. The two central questions in animal ethology are, "What causes this behaviour?" and "What purpose does it serve?". These are both valid in the study of games. The next four sections take a more detailed look at the behavioural questions.

Interaction (Causation)

[How does it work?] What player or other actions elicit the response, and how is it modified by changes in input?

Lorenz stressed the part played in animal behaviour by internal causal factors like hormones and instincts. Here the direct applicability of the metaphor is somewhat limited, but we can still distinguish between causation => internal => program logic; and development => external => what the user/player does. This aspect (what the player does) is related to but still distinct from what the player learns as it is possible to provide random input without really learning anything. When it comes to examining the roles that hormones have on animal behaviour, we are dealing with something specific to the actual physiology of living organisms so it is not directly applicable. If one tries to stretch a metaphor too thin, there is always the danger of losing sight of the original purpose of the metaphor and thus imposing limitations or perspectives upon an approach that are counterproductive. The details of what is discovered about the specific behaviours of various animals and how the four questions are addressed in any specific application are not particularly useful to the notion of instructional ethology – it is the process and the methodology that is useful.

"Ethologists cannot claim the entire field of Behaviour Physiology as their domain, for on the one hand Ethology has a wider scope, since it is concerned with other problems as well, and on the other hand, ethologists cannot claim the field of Behaviour Physiology as their domain, for **they have traditionally worked on the higher levels of integration, in fact almost entirely on the intact animal**" (emphasis added)(Tinbergen, 1963, p. 416).

This is why I am using Ethology - the study involves the entire entity.

Figure 6.7 Animal Crossing Wild World - Weeds 1

(source: Katrin Becker)
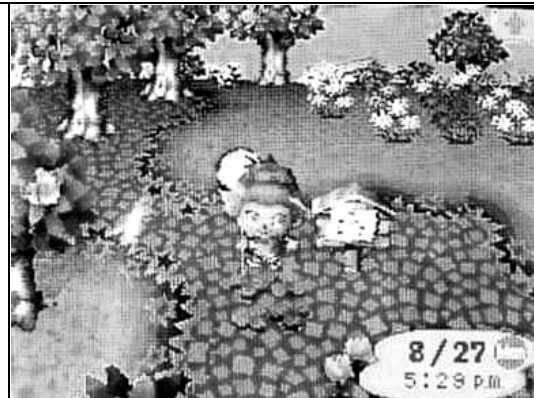
Figure 6.8 Animal Crossing Wild World - Weeds 2

(source: Katrin Becker)

An example of how the question of causation might be answered in instructional ethology uses a simple behaviour in *Animal Crossing*. The observed behaviour has to do with the appearance of weeds. Weeds appear in the game at the rate of approximately 3 per day. There are also occasional appearances of dandelions and clover. If left alone, the weeds remain and multiply and eventually a red flower appears that cannot be picked. It should also be noted that the appearance of the weeds differs from those of flowers. The actions that elicit a response include the internal one of the passage of time, and the external one is the player picking, or not picking weeds.

At this point this question still appears to have little to do directly with instruction. The observational process itself gathers relatively neutral data about the way the game behaves, and in answering the causal question it may not be possible to draw immediate connections to learning, especially when looking at the causation and interaction of a simple behaviour, but the process allows us to gather data that can then be analysed or mined collectively for learning connections. In this case, it is already known that the overall objective and purpose behind the 'weed behaviour' is to get players to

look after the town - the weeds affect the town's 'rating' which gets a good rating if there are few weeds and many trees and flowers (although there can be too many, which is again detrimental). Ultimately in the game, if a player's town achieves a perfect rating for enough consecutive days, they are awarded a Golden Watering Can. We know that town maintenance is one of the goals we can choose to pursue because we are told it is by the residents (NPCs). So it can then be said that the weed behaviour helps to teach players to look after the town. It should be remembered that the analysis attempts to uncover the **intent** of the design and cannot determine whether or to what degree it succeeded. The game itself was chosen for study because it was a highly successful game, thus it is assumed that many of the intended objectives are successfully realized.

Support / Function / Purpose

[What is it for?] How does the behaviour of the game help it to 'succeed' in the goal of helping players get through to the end?

In (animal) Ethology, claims that a behaviour supports survival or reproduction are often hard to prove, especially when a particular behaviour cannot be isolated for experimentation or other study. In Instructional Ethology the question is not one of survival in the same sense but there is an analogy - it addresses those behaviours (interactions, displays, and other game elements) that lead to the short-term continuation of gameplay. A game's 'survival' hinges on its ability to keep the player engaged and keeping the player entertained enough for them to encourage their friends to play. Part of this is done by providing the right kinds of support to keep the player from becoming too frustrated or bored and ultimately quitting and part is done by allowing the player to progress. Progress through the game is assumed to involve at least some learning on the

part of the player, whether it be a physical skill, a principle understood, or an ethical standpoint acknowledged.

This is the one question of the four that will differ significantly depending on the goal of the analysis. The methodology described for Instructional Ethology can also be applied to software generally, in which case it is referred to as Software Ethology, and it can also be applied to games generally, in which case it is called Game Ethology. In Software Ethology more generally this question asks how does this program help fulfill its goals: so for example in what ways and how well does this word processor help people in their task of formatting a document? If one were to analyse a game from an ethical or moral perspective and we were to apply Game Ethology, we would want to know how the game supports its particular moral stance. In Instructional Ethology, we are looking specifically at the learning support. This question is also the only one of the four questions not likely to be described in a typical game design document.

In Animal Ethology it is accepted that only the behaviour and not survival can be observed directly. This is also true in Instructional Ethology - when studying the application rather than those using it, we cannot make direct claims about the effectiveness of the support. That can (and should) be tested using human subject and methodologies already established to help determine the effectiveness of a particular instructional intervention. However an advantage we DO have in Instructional Ethology over studying animals is that it may be technically possible to remove or change a single behaviour and study the effect the result would have on its survival through user testing. Whether or not this is practical is a separate question.

Perhaps another example can help to illustrate how this question can inform
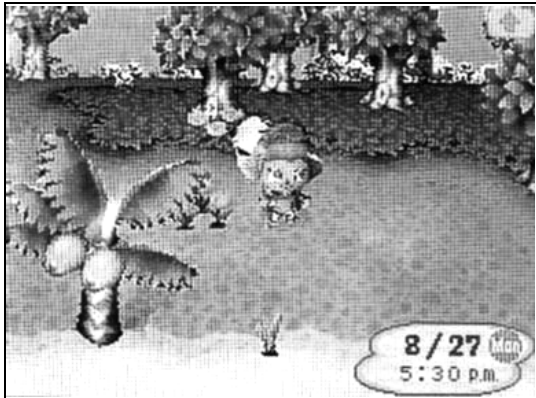
instructional design.

Figure 6.9 Animal Crossing Wild World - Weeds 3

(source: Katrin Becker)

Figure 6.10 Animal Crossing Wild World – Weeds 4

(source: Katrin Becker)

One of the goals that can be pursued in *Animal Crossing* is to look after the town.

There are a number of behaviours that relate to the 'survival' of the game when

considering town maintenance. Although weeds need to be pulled and flowers watered

each day, the total commitment required is not overwhelming so players can keep up with

the maintenance without having to devote a great deal of time. If they choose to ignore

the town maintenance completely, the weeds will multiply and residents will begin to

complain. However, if they choose to seek the 'win' for this part, they must continue to

tend and play for many days. Just like with animals, it is rare that any single element will

be found solely responsible for the organism's survival - rather many different things

contribute collectively. The question asked here seeks to answer what it is about **this**

behaviour that contributes to continued gameplay. Part of how the weed behaviour

contributes is by providing regular, pervasive, but subtle reminders. These ideas can in

turn be used to inform instructional games by showing how slow, incremental progress towards a complex goal can be realized through multifaceted support mechanisms. In some cases individual behaviours can be isolated and identified as supporting specific learning goals, but it will more often be the case that multiple behaviours will, upon analysis be discovered to support the same goal.

Game Ontogeny (Development, or Flow)

[How does it develop (change) during play?] How does the game's behaviour change as players advance (as from level to level), and what changes in the player are needed for the behaviour to be modified?

Ontogeny in the general sense is about the development (growth) of the individual organism from birth through, at least, reproduction, and often death. It looks at instinctive as well as hormonal reactions. In Instructional Ethology it is about individual behaviour, which looks at the logic that drives the program. So for example we might look at the behaviour of a specific word processing program, rather than word processors in general. A game's behaviour develops as well but we usually call it game flow.

Figure 6.11 The Life of a Game

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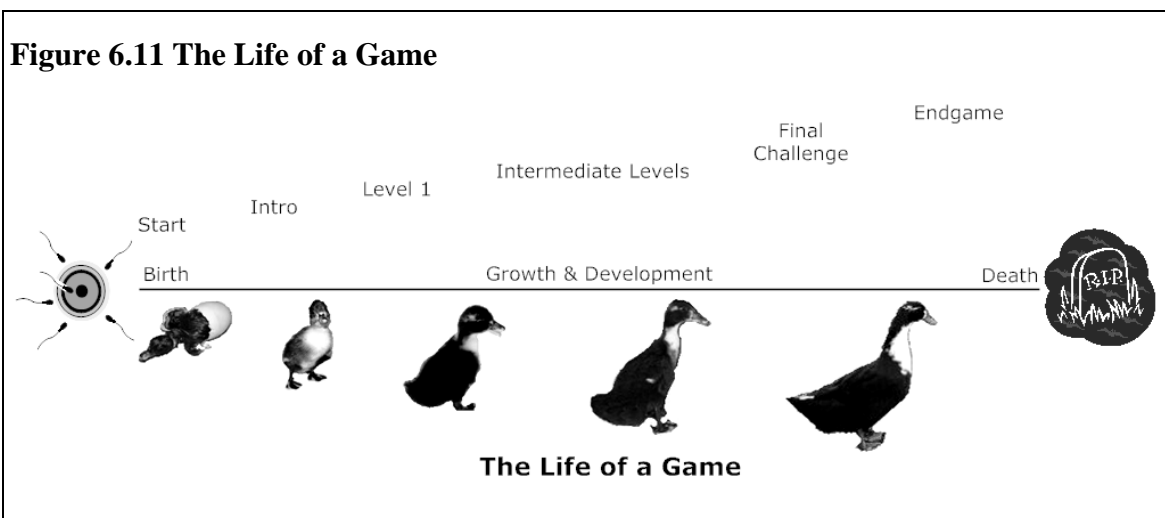
Image Source: K.Becker

Ontogeny deals with changes in the organism's behaviour as that organism develops (grows up and old). In games that translates to game flow and typically changes as players progress through levels or through time. With animals we ask how this behaviour is controlled, and the answer may include internal (physiological, hormonal, etc.) or external (weather, other animals) causes or a combination of both. In games, internal causes translate to the program's logic (the game's AI, or its physics or some other engine), or sometimes hardware elements. In the case of MMOs this may also include network elements. External control (or influence) comes usually in the form of the player. So, for example in Animal Crossing, when a player pays off a mortgage, they are given a bigger house. Although the player instigated the move by paying off the mortgage, being given a bigger house (with a bigger mortgage) has an internal cause.

When we examine 'learning ontogeny' in a game, we are focusing on how the changes in the game over time relate to expected advances in the player's ability. This element ideally links the game's flow to the player's learning. While it is always true that players may advance to the end of a game through random chance and blind guessing, this kind of approach is not the one the designers had in mind when designing the game, and it is rarely what instructional designers have in mind when designing instructional interventions. Perhaps not surprisingly, many 'good' games strive to keep players at the edge of their ability - a virtual embodiment of Vygotsky's "Zone of Proximal Development' (Vygostky & Cole, 1977). Examining the game's ontogeny effectively looks at how the game keeps players at the borders of their ZPD, and in fact many successful games do not force players to remain there at all. It is often possible to 'retreat'

to a part of the game that they have already completed, but that is a behaviour that supports game survival rather than explaining game ontogeny.

Classification / Evolution

[How did it evolve?] How does the game's behaviour compare with other games in the same genre and how is it related to other genres?

Here we have a significant difference between the original discipline in Biology and the adaptation as applied to software. When observing games we have what amounts to multiple instances of a single, identical game (clones?) rather than a population of genetically similar but distinct individuals. So, instead of observing and comparing behaviours of many similar individuals, we can only observe a single game but can do so in multiple instances. In other words, the same game can be played multiple times, and (especially in highly complex games) the different experiences can lead to different insights.

Obviously, games are not bound by any kind of genetic relationships, nor by true evolution, but they are still categorized by genre, which of course has its roots in taxonomy. While novel approaches to known genres are possible as well as combinations of several genres embodied in a single game, the metaphor remains useful as most games can be classified by their primary form, such as a shooter, or a puzzle game. Further, genres and their definitions change over time, and evolutionary perspectives can easily be applied to how that happens as well as to changes that happen over time to what's on the screen during play, to how many sequels the game will generate. Actually, genres can easily be related to traditional taxonomy - there are families of games and players expect certain things from certain types, etc.

Animal Crossing has some aspects in common with other simulation games like *The Sims* in that there are multiple goals that can be pursued, and that there is no 'Game Over', among other things. If one views it as a simulation game, then that sets up certain expectations, which, if too divergent may negatively affect the game. *Animal Crossing* also shares aspects of roleplaying games in that players are placed in an existing 'world', players have limited control over the appearance of their avatar, and certain actions are required.

Examining how a behaviour may have evolved from similar behaviours in similar games can provide some insights into the kinds of designs that are successful, which in turn can again indicate important design considerations for instructional games. For example, while it is clear that participants in a learning environment must be encouraged to try the entire variety of activities it is not always clear that they must be forced to work through them in a predetermined order, and it is especially clear that they should not be prevented from re-doing activities. In *The New Super Mario Bros.*, although access to worlds and even individual levels is earned through points and other achievements, once these have been attained players are allowed to go back to any previous world or level and go through them as often as desired. There are even some that are known to be helpful for gaining additional lives and power-ups. They can sometimes serve as confidence boosters when players are struggling with a particularly challenging section. For example, returning to the very first course is always permitted and since it is an easy course to complete, doing so is an easy way to re-open a Mushroom House which in turn will allow you to gain extra lives. Not only can it be nice to go back to a familiar section and do well, one can gain numerous lives which can in turn be used on attempts at more

difficult worlds. This repeatable behaviour has become standard in *Mario* games over time - it has evolved. By contrast, in *MathBlaster* there is only one path through the worlds and courses, and it is determined by the game itself. The player has no choice. The path does not vary, and although the player may choose one of eight different problem sets, each one takes the player through exactly the same levels and sections in exactly the same order. Only the numbers change. The only way a section can be repeated once it has been completed is to restart the game and discard all previous achievements. Had the designers emulated the more successful design of *Mario* players would experience less frustration (Becker 2007b).

A Comment on Darwin and Survival

Lorenz thought that behaviour patterns should be considered as "organs", and should be studied as such. After Darwin there was a reaction against uncritical acceptance of selection theory. Unfortunately, rather than responding by improving methodology, biologists responded with a loss of interest in the problem which, at its extreme became an attitude of intolerance. The study of games could easily fall into the same trap if we restrict ourselves too early to certain approaches, methodologies, or domains. We should not confuse teleology with the study of survival value. In studying animals, both the contribution of a behavioural organ to survival and its causation are to be studied. In studying game or other software behaviour both questions are also useful, although in somewhat different ways. "What is this good for?" speaks to objectives, and "How does it work?" speaks to design.

In biology survival deals with the continuation of an individual long enough to reproduce which in turn supports the survival of the species. In a game (or other

software), "survival" deals with the continuation of the game. In general terms, a game's survival has to do with how successful it is at keeping people in the game as well as at doing what it was designed to do. For an entertainment title, that means how well it entertains, which in turn is evidenced by how well the games sells and how well it is rated by reviewers. For an educational game it could mean how well the game delivers on its stated instructional objectives, but it could also be affected by institutional factors. So, for example a game like *The Typing of the Dead* may do an excellent job of helping people learn to touch-type, but if it cannot gain any acceptance in classes where typing is taught, it has a low survival ability. In this case, it is likely the game's genre - a former zombie shooter - works against its survival. With some games, it may be the very thing that makes that game distinct that is attractive to some and repulsive to others.

It must still be remembered that "behaviour rather than survival is the thing we observe directly" (Tinbergen, 1963, p. 418). It is also true that survival is sometimes hard to prove. This is also the case in games. Games are not subject to selective pressures in the same way as animals are and they haven't had nearly as long to 'evolve' as animals have. However, we may still be able to learn some things about what makes a good (= successful) game through this lens.

If we continue along the path of this analogy, once we get into genetics there is a big difference between animal and game ethology. When looking at games we have just one 'individual' (although there are sometimes sequels). We do not have a population, and instead of multiple individuals doing similar things we have identical instances of a single game being played multiple times. The metaphor has limited but still not entirely inappropriate application here.

With animals it is hard to isolate behaviours – the fact that ducklings synchronize their eating and sleeping times can not easily be experimented with in a natural environment. We cannot take away that which causes them to synchronize, and see how survival is affected, though we can readily speculate that having a brood of ducklings doing different things at the same time makes them nearly impossible to supervise, which in turn is likely to negatively affect survival. In games it can also be difficult to isolate behaviours if one does not have access to the original source code, and even then it may not be designed in such a way as to allow for selective changes. The observed behaviour may not translate into chunks of code that can be altered without side-effects. So, for example changing a display parameter may be relatively easy, but changing the conceptual coherence of the gameworld may not be.

Naturalists observe similarities and differences between species. These are attributed to one of two sources and both concepts are useful to examinations of behaviours or entities (intended to be analogous to Lorenz's 'behavioural organs') in games. One source is *affinity* (similarity) which implies that there is a common descent - a similar behaviour seen in different species exists because it belonged to a common ancestor. The other source is ***convergent evolution***, where different species develop the same behaviour, possibly due to similar external forces. In games, there has in fact been both affinity and convergent evolution in evidence (after a fashion). Many adventure-style games share similarities with what is often recognized as the [first adventure game](#) (*Advent*). First Person Shooters (FPS) all have similar kinds of objectives & rewards, camera angles, and other aspects. There has also been a convergence of form in many displays. The status displays found in many games (H.U.D. Head's Up Display) has

become more consistent, possibly as players become accustomed to seeing information displayed in a particular way. There are many reasons for this kind of convergence in application software, but perhaps one that exerts the strongest 'selective advantage' is that a similar look and feel cuts down on the amount of time it takes to get used to using a new program. As a result, we become accustomed to seeing the 'button' for opening a new file looking like a tan cardboard file folder that is open.

By examining a game's 'evolution' to see what may or may not have survival value, we may be able to gather new insights. Even if the 'behavioural entities' identified this way do not have direct or obvious application to instructional design, they can have important implications to the overall design of any game of a particular genre and so should be considered when designing games for education. Looked at another way, it would seem counterproductive to disregard clearly successful entities simply because we cannot see a direct instructional application.

Process

In Measuring Behaviour (2007), Martin and Bateson offer a general flowchart for the steps that are involved in conducting research on behaviour. This flowchart is shown in Figure 6.12. Given that the approach to studying digital games described in these pages is new, there has not yet been sufficient time to perform detailed tests of all of the steps.

Figure 6.12 The Steps to Researching Behaviour
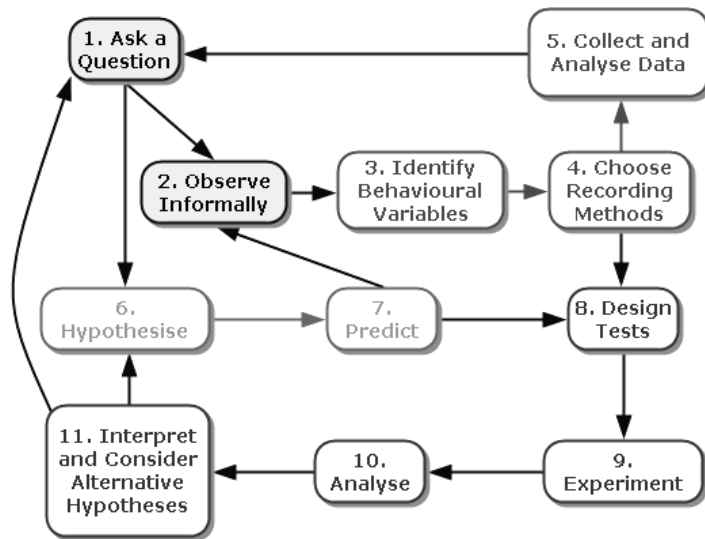
Martin & Bateson, 2007, p.30

In particular, the latter steps are ones that require further research. The first step in the case of Instructional Ethology was taken at the start of this work, namely to formulate the main thesis question. Thus the main question to be addressed through this methodology is, "How does the game help the player learn what they need to learn in order to succeed in the game?" The second step, namely the preliminary observations were completed using both a strictly commercial game (*The New Super Mario Bros.*) an educational game (*MathBlaster*) (Becker 2007b). The purpose of this step is to help focus on what to measure. These steps are very much the same for the study of all behaviour, regardless of what is is we are observing. It is in steps three and four where the details diverge. The kinds of variables of interest to the study of games will necessarily be different from the kinds of variables of interest to animal behaviourists. Animal ethology is concerned with such values as latency, frequency, and duration which are not typically applicable to instructional ethology unless one is trying to understand fairly classical behaviourist training outcomes. This can certainly be done, but is not a goal of this research. Instead, this research seeks to inform educational game design at a higher level.

However, distinguishing between **structure** and **consequences** as is done in animal behaviour studies IS just as important here. **Structure** has to do with the appearance whereas **consequences** are the effects. In instructional ethology it is important not to descend to too low a level when describing structure, so, for example, "Dig a hole" might be an appropriate structural behaviour description in *Animal Crossing* as opposed to "Press the A button". The **consequences** of digging a hole will vary depending on where the avatar is - it could result in simply creating a hole, but it could also result in trapping the avatar in place, uncovering a fossil or bug, or the destruction of a young tree, each of which may in turn have different outcomes.

In order to distinguish various general types of behaviour it is necessary to develop some terminology that can be used for description. Animal Behaviour studies offer three general terms for this: **event**, **state**, and **bout**. The first two have meaning in computer science, and thus also to game design generally so they warrant definition specifically for instructional ethology. An **event** is a behaviour pattern of short duration - in a game this would be one that is not interruptible and must be followed from its inception to its conclusion, even though the conclusion may vary depending the on choices made along the way. Dialog exchanges in *Animal Crossing* have this property: the player cannot choose to leave a conversation until it is complete, but there may be several points during the event when the player may choose from among several responses, thus affecting the outcome. By contrast, a **state** is a relatively stable, potentially longterm condition which may or may not be instigated or terminated by another event. A **bout** is essentially a set of events. Two others have been added by the author in game ethology to permit somewhat finer distinctions: **step** and **theme**. A **step** is

an atomic operation that is not made up of other distinguishable actions, and at the other

end of the spectrum, a **theme** may include many events and bouts. For a more detailed

discussion of these terms and examples, see Appendix E.

In instructional ethology, the preliminary steps taken during the ontological

analysis will normally serve to identify the various entities within the game, such as the

types of non-playable characters (NPCs) as well as their static relationships to each other.

This provides a structural framework for the behavioural descriptions used later. As this

approach has not yet had the benefit of 40 years of practice, the most appropriate kind

sampling is still 'ad libitum sampling' (Martin & Bateson, 2007), which here means that

no systematic constraints are placed on what is recorded and when.

Summary

Instructional ethology uses two approaches to examine a game that have not been

used in this way before. The first applies techniques from ontological excavation to

uncover the static structural anatomy of the game. In some cases the game's design

document may be accessible, in which case this step may not be needed. The second uses

the four primary questions asked in animal behaviour studies to examine game behaviour.

These questions are meant as guiding questions in animal ethology rather than edicts as it

is not always possible to separate behaviours or explanations neatly into categories when

studying animal behaviour. This is also true of Instructional Ethology - partly for the

same reasons. This is not typically how the games were originally designed or developed

in the first place. Ultimately, it remains important to remember that this is a metaphor

being used as a tool to study games from an alternative perspective in the hope of

discovering something that can in turn be applied to the development of other games.

"Since studies of survival value show us that there are often direct contradictions between different selection pressures, the animal that survives must be a compromise, and it must be one of our main tasks to try and find all the pressures - favourable and unfavourable alike - that can have affected any character we select for study. In general, we should not only try to pinpoint isolated selection pressures, but study their interaction as well" (Tinbergen, 1963, p. 429).

The same can probably by said of educational games as well: there are often direct contradictions between different objectives, stakeholders, and other influences. For an educational game to 'survive' (i.e. be accepted and used) it must be a compromise, balancing the pressures to create an effective educational object that remains a viable game.

There are many parallels and many ideas from this approach to the study of behaviour that are useful but it must also be remembered that in software and instructional ethology we are in fact studying a program (which is an entirely man-made artifact) and not a living thing. However much people may wish to imbue programs with anthropomorphic characteristics and/or intelligence, we are not there yet. As the character Rube from *Dead Like Me* said, "When computers go postal on a meter maid, or when a computer kills itself because it thinks it's getting too fat, then I'll believe in artificial intelligence.". We do not yet have intelligent machines.

The studying behaviour metaphor is useful, but only goes so far. For example, there are no truly natural selection pressures on programs, but there are cultural, social, and economic ones. These are selection pressures to be sure, but they work somewhat differently from the way they work on living organisms. While potentially quite

fascinating and informative, a detailed study of game evolution is beyond the scope of the current research.

CHAPTER 7 THE INVENTION OF GOOD GAMES: ANALYSIS & RESULTS

"One of the most difficult tasks men can perform, however
much others may despise it, is the invention of good games.
And it cannot be done by men out of touch with their
instinctive selves." *- Carl Gustav Jung*
Laurens van der Post in Jung and the Story of Our Time
(New York: Vintage Books, 1977), pp. 41 [27]

The major contributions of this research are the explicit connection of game

design to existing pedagogy (instructional design theory & models), a methodology for

ranking games, and the creation of new methodologies for analysing digital games.

Although the methodology is the main contribution to new knowledge, it is insufficient to

propose a new methodology without providing some insight into the kinds of things that

can be learned from its application and at least some preliminary results from using it.

This chapter outlines those preliminary results and describes what has been learned. The

approach is largely hermeneutical as the work attempts to understand and interpret, from

an educational standpoint in this case, both linguistic and non-linguistic expression as

seen in digital games (Ramberg & Gjesdal, 2005).

When this research began, the primary focus of the investigation of commercial

games was to discover how a successful commercial game helps players learn the things

they need to learn in order to finish the game. To that end, three commercial games were

examined, and each item that was identified as something learned was examined to see if

it was indeed necessary in order to win, and if not whether it was something that was

intended to be learned or learnable (i.e. designed into the game) or if it was collateral

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[27] Thanks to Chris Crawford for correcting the wording and Warren Spector for tracking down the source of the quote.

learning (unintentional design). This work was intended to uncover mechanisms used to help players learn the things they need to learn but not to assess the efficacy of those mechanisms[28] . The use of top rated commercial games is taken to imply that these mechanisms work *well enough* to result in the game's popularity. This phase of the work resulted in numerous insights that will be described later in this chapter (see the *First Grasp* sections under Specific Results and also the General Results section).

However, the informal, ad hoc approach did not offer much in the way of repeatability or rigor and a more structured framework was still needed in order to allow for a more defensible analysis. Given that the object of analysis is a software application, approaches in software engineering were an obvious place to turn for methodologies that could be applied. Unfortunately, existing approaches to the analysis of software from software engineering are intended to provide insights geared towards refurbishing or improving the application and that is not the goal here. Two other places to look for methods that could be appropriated are educational technology and human-centered design. Again, existing approaches in both user-centered design and educational technology tend to focus on the user, and educational technology assessments often involve learner assessment or expert review, none of which could be applied to the analysis of an artefact like a digital game if the goal is to examine the game itself. Assessments involving users/learners are important and necessary, but when it comes to the design of something as complex as a game they are insufficient. To address this gap,

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[28] There is no intent to imply that efficacy studies are not needed. In fact they are essential and one of the areas identified by many in the field as under-represented. The statement that the current study does not examine efficacy is simply an explanation that this study is taking a specific approach.

the methodology described in Chapter 6 was developed, and this chapter presents some results that came from preliminary analyses using this approach.

The ranking method applied in Chapter 5 resulted in five candidate games and five 'runners-up' that could be used as subjects. The initial five games were examined, but two of them had to be disqualified as they proved unsuitable for the purpose here (the reasons are explained below). This left three games to examine, one of which was studied extensively and the other two somewhat less so. The three final games are described below, as well as an explanation for why two of the original five were eliminated. Then the data collection is discussed, followed by specific insights gathered for the three games and finally general conclusions drawn from the work. Clearly, as this methodology is new, there is little to compare it with, but the potential for new contributions to our current understanding of educational game design is clear, and that is discussed in the final section.

The Chosen Games

Five games were chosen for analysis, but as was stated previously two were eliminated. In the end it became clear that three games would provide sufficient data to explore the main questions and the 'runners up' would not be needed. The original list consisted of: *Animal Crossing Wild World*, *Grim Fandango*, *Black & White*, *Katamari Damacy*, and *Metroid Prime* . All five games placed in the top half of the final "top 100" list (see Table 4.6 in Appendix D). Of those in the the original list of five, both *Grim Fandango* and *Metroid Prime* proved unsuitable albeit for different reasons which are explained below.

The Games Not Chosen

Grim Fandango was initially a promising game with intriguing design, but there was little in the way of help if players got stuck. Unfortunately, this is quite an old game (released in 1998) so there were also few players to consult[29]. The game revolves around a character named Manny who has just died and landed in the first circle of the underworld. According to the introduction to the game, the underworld consists of nine rings and one's soul cannot rest until passage to the center ring is earned. This is done through the collection of souls. Thought the story may sound quite morbid, this game takes a humorous approach and along with interesting tasks and challenges, the dialogue sequences can be very funny. In fact some players have reported that they go through all possible options just to see what the characters will say. One of the more intriguing approaches occurs early in the game. Players discover that actions in one place may have effects elsewhere. This is a fairly common tactic in games and one of the things that distinguishes good design from bad is the distance, both of game time and play space that separates the opportunity to acquire an item and where that item is required. Unfortunately, there are no clear rules for 'calculating' those distances as they are influenced by the target audience, genre, playstyle, and other factors. At one point in the game players find they can break into the boss's office (Don Copal): the boss is not in his office, but if the player explores the room, it will be seen that Don has a computer with automated responses loaded onto it. These are responses that appear to be for a secretary.

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[29] Unofficial game guides exist, but it was decided that these would NOT be consulted - only the officially sanctioned guides would be consulted as they could be considered part of the game, and the ones for *Grim Fandango* did not help here.

It is possible for Manny to choose among the various responses. Later in the game, players discover that when they ask the secretary for something, she uses her intercom - and the automated response that was selected is the one that gets played - if players picked badly, they now have to go back and get into the office again (which involves leaving the building, scaling a wall and climbing in through the window), change the response, and then come all the way back to ask the question again. The secretary will wait for Manny (the player) without comment, but without selecting the correct response, players can not get what they need - which in this case is a signed work order. *Grim Fandango* separates the needed item by sufficient distance to make retrieval a nuisance (a natural consequence), but as there are no other penalties, it is a lesson learned, and players will be more vigilant as a result as they continue in the game.

Metroid Prime was discarded relatively early on as the author could not discover how to get past the initial scene. When a more experienced player was asked about this, it was discovered that many players require the help of game guides or other players to get started. Since the object of the current investigation was to discover how the *game* helps players learn, a game that required outside help would be unlikely to provide the desired information. Although it may be possible to discover learning support in this game once the player has passed the initial steps, this research is largely exploratory and it was felt that examinations of games should begin with games that do not offer insurmountable learning challenges. Eliminating this game was disappointing, as it is one of the few that features a female bounty hunter (Samus) as the hero. This game is a first-person shooter that takes place on a poisoned and abandoned planet, where pirates have retreated to the core and are trying to rebuild and harness the power of the poisonous element that had

been released. The original version of this game was released in 1986, and it has been

popular ever since.

Animal Crossing Wild World
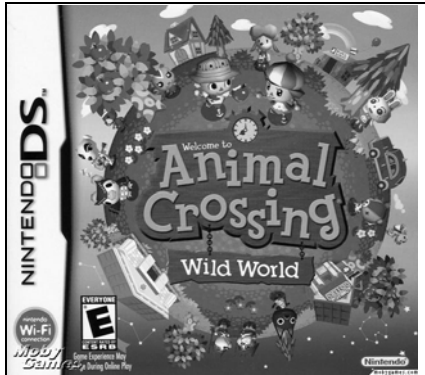
Figure 7.1 Animal Crossing Wild World Box Cover
Image Source: MobyGames.com

Animal Crossing Wild World Nintendo

(Designer) [Game] Nintendo EAD (Developer) (2005)

[Nintendo DS] Published by Nintendo of America Inc.

Game Site

Animal Crossing Wild World is the Nintendo DS

Figure 7.2 ACWW map
Image Source: Katrin Becker

version of *Animal Crossing*. It is an open-ended game where the player becomes a resident in a small community that consists of numerous permanent and temporary residents. The gameworld is relatively

small and consists of a number of permanent buildings (the Town Hall, Museum, Tom

Nook's Store, the Abel Sisters' Design Shop, the Town Gate, and the player's own house),

as well as temporary houses that serve as residents' homes. The population of residents

changes over time as some move out and new ones move in, but there are never more

than eight residents at any given time. The map shown (Figure 7.2) is the configuration of

the author's game (residents houses change over time, but other elements remain the same

throughout the game). A legend identifying the structures can be seen in Figure 7.3.

Figure 7.3 ACWW map symbols							
	Player's House		Town Gate		Tom Nook's Store		Abel Sisters' Design Shop
	Museum		Town Hall		Resident's House		Image Source: Katrin Becker

The landscape includes areas where trees and flowers can be cultivated, an ocean coastline, a river, ponds and waterfalls. The player can engage in numerous activities such as gardening, fishing, designing patterns for clothing and other things, collecting furniture, etc. This game supports a multiplayer mode that makes use of the DS' Wi-Fi capabilities, but as the current study focuses on how the game supports learning, the multiplayer mode was not employed. The game permits a player to maintain up to four avatars at a time, but only one can be active in the game during any single session.

Katamari Damacy

Figure 7.4 Katamari Damacy Box Cover
Image Source: MobyGames.com
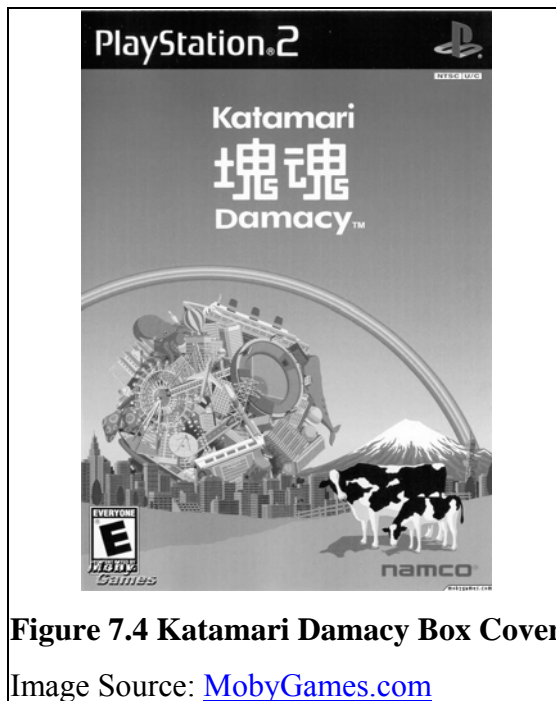
Katamari Damacy [Game] Namco (Developer) (2004) [PS2] Published by Namco. Game Site

Katamari Damacy is a well-known, critically acclaimed game with a relatively simple goal, which is to roll up objects into a large 'ball', called a katamari. The main premise for this game is that the King of All Cosmos has accidentally destroyed the stars in the sky so he charges his son, the Prince with replacing them. This is to be accomplished by going to Earth with a sticky ball called a katamari and rolling it over various objects. As the Earth is deemed to have a great many items, the Prince is to roll up as many as he can in a given time period and the King will launch the resultant ball into the sky to create a new star. There are also constellations to be made which include a additional challenge of rolling up specific kinds or objects, such as bears to create Ursa Major.

Black & White
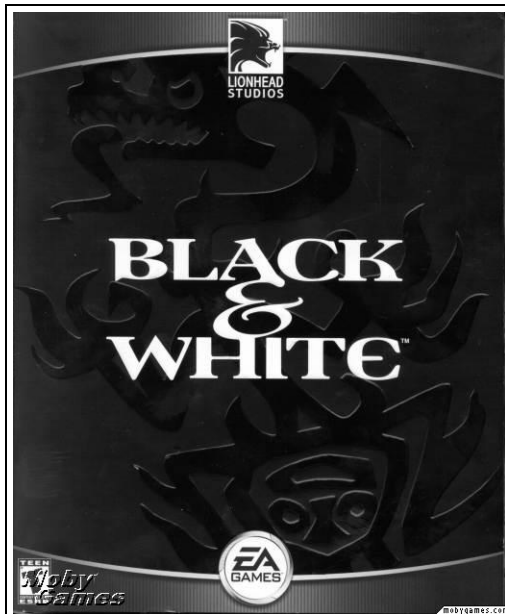
Figure 7.5 Black and White Box Cover

Image Source: MobyGames.com

Black & White Molyneux, P. (Designer) [Game] Lionhead Studios (Developer) (2001) [PC] Published by Electronic Arts. Game Site

Black & White is a 'god' game, where one plays a fledgling deity, called upon by people in need. It is a game about exploring ethics and morals where the player can influence the behaviour of the game and can move items or affect the weather, but where the player does not represent a specific character within the game. Instead, the player is allowed to choose one of several animals to look after that is affected both behaviourally and developmentally by the choices the player makes.

"*Black & White* belongs to the god-game genre popularized by Lionhead arteur Peter Molyneux in the *Populous* series - the player is literally a god, helping his or her people prosper, through guidance and miracles. The showpiece is the Creature, which is a living animal avatar that the player raises from childhood, shaping its personality by reward and punishment. The Creature is a complex, semi-autonomous artificial intelligence, whose nature changes as it grows - like the player-god, the Creature can become good or evil, black or white. *Black & White* is an ambitious accomplishment - apart from its originality, it features fluid, epic-scale storytelling, gorgeous graphic presentation, and an elegant, versatile mouse-based interface" (Molyneux, 2003, p. 151).

The game takes place on an island populated by primitive villagers who turn to the player for help, guidance, and protection. The gameworld is a three-dimensional world that can be freely explored guided and counselled by two entities: one clearly intended to represent 'good' (White) and the other 'bad' (Red), though the consequences of the suggestions made by each aren't always as clear-cut.

Data Collection

ACWW was studied most extensively with over 500 hours of play logged. *Katamari Damacy* and *Black & White* were examined less extensively, with approximately 20 hours spent on each game. Data was collected in three different ways while each game was being played: 1) transcription of dialogue, 2) informally through open-ended journaling about what was learned and how the game supported the acquisition of that knowledge, and 3) through formal structured ethological observation. Each provided different perspectives as outlined below.

Dialogue

Transcribing dialogue is a step that is often not necessary if game design documents are available, and dialogue is scripted explicitly when the game is developed. Transcribed dialogue from a game can be approached from two main perspectives. On the one hand it can be treated as 'talk', in which case it can be analysed using known methodology in discourse analysis. On the other hand, it can also be treated as a script, like that of a film or play, in which case methods used in script analysis and literary criticism may be appropriate. In the present study, transcribed dialogue is used primarily

as reference material and is examined as necessary to identify modes and methods of instructional support.

Informal Observation

Informal observation of the games proceeded by keeping a journal on gameplay as the games were being played. Specifically, the progress through the game was documented and it was noted what needed to be learned. Although informal, this process was not completely unstructured, and data was gathered in a database that allowed for the creation of lists sorted in various ways. The game, console, date, time, duration, and several other details were recorded. Notes were kept on what was learned and how it was learned, as well as whether or not it was necessary to getting through the game. One of the significant outcomes of the informal observation was the discovery that learning in a game could be roughly categorized into several groups according to its relevance to getting through the game. A more detailed discussion of this categorization of learning can be found in Chapter 8 (see Magic Bullet).

Formal Observation

Since the kind of observations being made when studying a game are quite different from those made when studying animals, data collection variables evolved as the observations proceeded and categories began to become evident. Data collection for behavioural observations share many qualities with case study research, and there is no definitive approach that can be prescribed (Stake, 1995). For a detailed description of the variables used, see Appendix E - Game Behaviour Data Collection. Given the nature of many games, there are, for all intents and purposes, and infinite number of combinations

of actions possible in many of them so it is not realistic to expect that any ethological study will result in an exhaustive list of behaviours. This is especially true of open-ended games that encourage exploration. Both *Animal Crossing Wild World* (ACWW) and *Black & White* (BW) would qualify as open-ended games, while *Katamari Damacy* (KD) is not. Also, given that we are dealing with a program rather than a living being, certain "patterns of behaviour" will start to emerge as data is collected. For example, in *ACWW* certain kinds of dialogue exchanges are associated with specific conditions: residents will comment on the avatar's appearance if it has been bitten by a bee during the session and offer hints on how to avoid getting bitten; residents will tell the avatar that there is no need to water flowers when it's raining, but only when it is actually raining.

Specific Results

The following section reports on observations made of the three specific games that were examined, first from an informal perspective, described in the sections titled "First Grasp" and then from a formal ethological perspective, described in the sections titled "Inspection of Detail".

Using informal observation, data was gathered based on two guiding questions: "What must be learned in order to get through the game?", and "How does the game support that learning?". Each time something was discovered or learned, it was recorded and categorized as 'must learn', 'could learn' or 'collateral learning'. The third category is of least interest in this particular study as it is the deliberate design supporting learning that is of primary interest here.

The second approach is more formal and observations were made first and then analysed afterwards to find connections to learning.

Animal Crossing Wild World

Animal Crossing Wild World has a fairly comprehensive tutorial built in to the start of the game which cannot be avoided by players. The game begins in a taxicab, with a driver that asks the player questions. The 'physical' appearance of the player's avatar, including its gender depend on the answers given to the cab driver. The avatar is dropped off near the Town Hall with instructions to go inside and talk to the clerk. The clerk demonstrates how to view the map and find the player's house, whereupon the player is instructed to go check out the house. On arrival at the house, Tom Nook (the storekeeper) approaches the player to tell her that she owes a mortgage on the house (19,800 bells) and offers to hire the player in his store. At the store, the player is given various tasks which include all the basic actions required to play the game, such as changing clothing, talking to residents, delivering items, planting trees and flowers, writing letters, and a few others. Once all of the activities have been completed, the player is 'let go' and may begin playing as she chooses.

There are a great many activities that the player can take up and two are described in some detail in the following sections.

First Grasp

The initial examination of the game was an informal one which involved keeping notes as the game was being played. Readers may refer to Appendix F for a more complete list of collected data. The following Table 7.1 shows several examples of things learned this way.

Table 7.1 What I learned in Animal Crossing

What I learned	How I Learned It	Game Goal
There are many choices: some things need to be learned to meet goals e.g. sea fish are typically worth more than river fish.	noting how much I made when selling my fish to Tom.	general
how to identify dead flowers: they are the same shape, but all brown. This is useful for keeping a healthy flower population - you can't keep enough flowers through just planting, and it helps to know which flowers to water.	told by residents ALSO: I noticed that it happened to a flower I knew I had planted. At first I thought these brown things were more weeds and I just pulled them. They disintegrate when pulled.	for environment
the Axe becomes worn and eventually will break.	The image of the axe changes gradually, and then one time it breaks.	If you want to cut and plant trees
only some places are good for growing trees	sometimes when I plant a tree is just dies; residents sometimes talk about trees dying if you plant them in the shade	if interested in environment
There are many choices: some things need to be learned to meet goals e.g. sea fish are typically worth more than river fish.	noting how much I made when selling my fish to Tom.; Must keep track of details	general
certain kinds of items can be used only in certain contexts.	when presented with a choice (selling, donating items, etc.) only permissible (although not necessarily wise) choices are highlighted	general

One of the activities players can take up is collecting. There are a number of collections that can be pursued: all have at least one mechanism for keeping track of what has already been collected, though none offer complete lists of what can be collected in the game itself. For example, there are over 500 different furniture items that can be collected, some of which are common and others rare. Others still can only be acquired under specific circumstances or from specific NPCs. All of these items have point values associated with them, and these are used to calculate a score for 'decorating', and this score is told to the player in the form of a letter sent by the Happy Room Academy once per week. As with all other themes, there are rewards for achieving various point scores.

The official game guides have full listings of some collections including fish, bugs, and fossils. Though it is not possible to determine which items are missing from a collection, in-game inventories provide information on the total number of items available as well as how many have been collected to date. Some collections such as fish and bugs also provide additional information on each item (Figure 7.6 Image 01). Rewards are given for completing collections.

Once the player has finished the initial tutorial portion of the game, they are left to pursue whatever goals they choose, but in wandering around the town they will inevitably cross paths with various residents who will, from time to time indicate that they wish to speak to the player. It is always possible to ignore them but since a common means of getting information in a game is through the NPCs, it would be silly to ignore them completely. Through 'conversations'[30] with NPCs, players learn more about various aspects of the game including the kinds of activities that can be taken up and hints on how to succeed at many different aspects of these activities. For instance, a resident may approach you and tell the player that brown flowers can be revived by watering. Other times a resident may invite the player to write them a letter of give them a specific kind of gift. They may also challenge the player to a contest of some sort (see Figure 7.6 Image 05 thru 08). In this game it quickly becomes clear that the negative consequences for making a poor choice are rarely severe so trying something different involves little

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[30] These 'conversations' are interactions in the form of scripted dialogue sequences designed to look like talk.

risk. The player cannot die, and as the game is built to proceed in real time, there is rarely any time pressure[31]. NPCs may also give gifts to the player.

The overall approach to helping players learn what they need to learn in this game includes providing invitations, suggestions and guidance throughout the game. Since this game is intended to allow players to explore and pursue goals of their own choosing, it is important that the support not be punitive or demanding. Almost all activities are connected with some reward structure and everything done in the game helps to further one or another goal. Players always have easy access to inventory and scores and there is rarely any penalty for taking the time to inspect one's status (unless of course one misses a short-term event such as when the flying saucer makes its appearance). A design such as this could work well in a learning game if the objectives were order-independent. In other words if a number of objectives were related but order independent. An example might be a social studies unit where learners are to find out about the different economic resources of an area. The goal would usually include learning about all of them, but which is learned first is unimportant.

Inspection of Detail

A detailed description of the whole game would easily fill an entire volume on its own and so is beyond the scope of this report. However, several specific examples will be outlined here. Just as it is often true that knowledge in context is easier to understand than

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[31] Occasionally, contests are timed or requests have a time limit associated with them, but even then if the player fails to meet the deadline, the worst that will happen is that the NPC involved will chide the player. The only exception to this is if the player terminates the game by turning off the console or taking out the game cartridge, rather than stopping the game by going through the quit sequence. In that case a mole will appear at the player's house the next time the player starts the game and deliver a lengthy lecture about how

disparate facts, examining game behaviour results in a richer description if the individual events are seen within the larger context of a bout or a theme.

When looking at behaviour, there are many distinct themes, such as: gardening, fishing, fashion design and collection, furniture collection, bug catching, fossil collecting, paying off mortgages, creating constellations, and nurturing relationships. Each has clear goals and rewards, but only the mortgage and Nook's store and memberships has distinct levels. There are other objectives with different goals for different levels of achievement, but they do not have clear levels. Different levels of the mortgage goal are associated with different house sizes (and mortgage amounts) and the player has no choice over whether or not to advance, and Nook's store will grow as the amount purchased does, and store discounts are available for various membership levels.

To illustrate what can be learned from an ethological analysis of this game, two themes are described in detail below.

Fishing

Figure 7.6 Animal Crossing Wild World Fishing Screenshots

| Image 01 | Image 02 | Image 03 | Image 04 |

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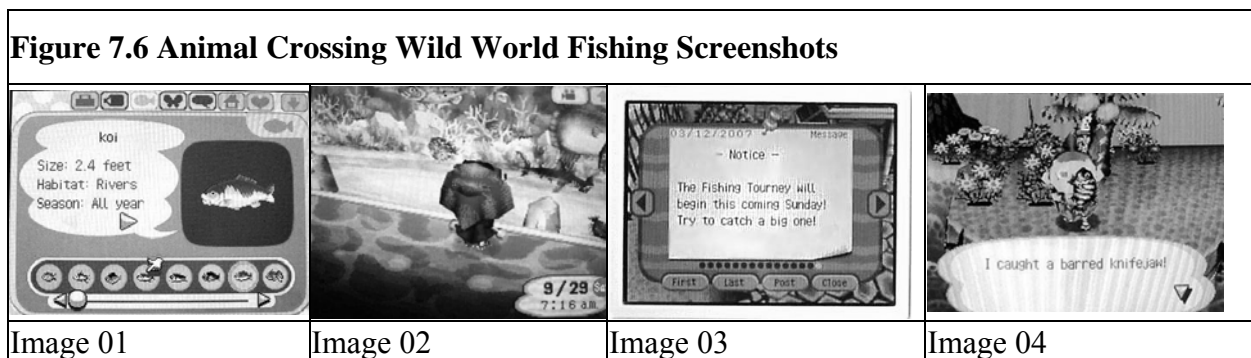
one should end a play session. This 'lecture' is long and tedious and there is no way to skip it, so players quickly learn not to end the game abnormally.

Image 05	Image 06	Image 07	Image 08
Image 09	Image 10	Image 11	Image 12
Image(s) Source: Katrin Becker			
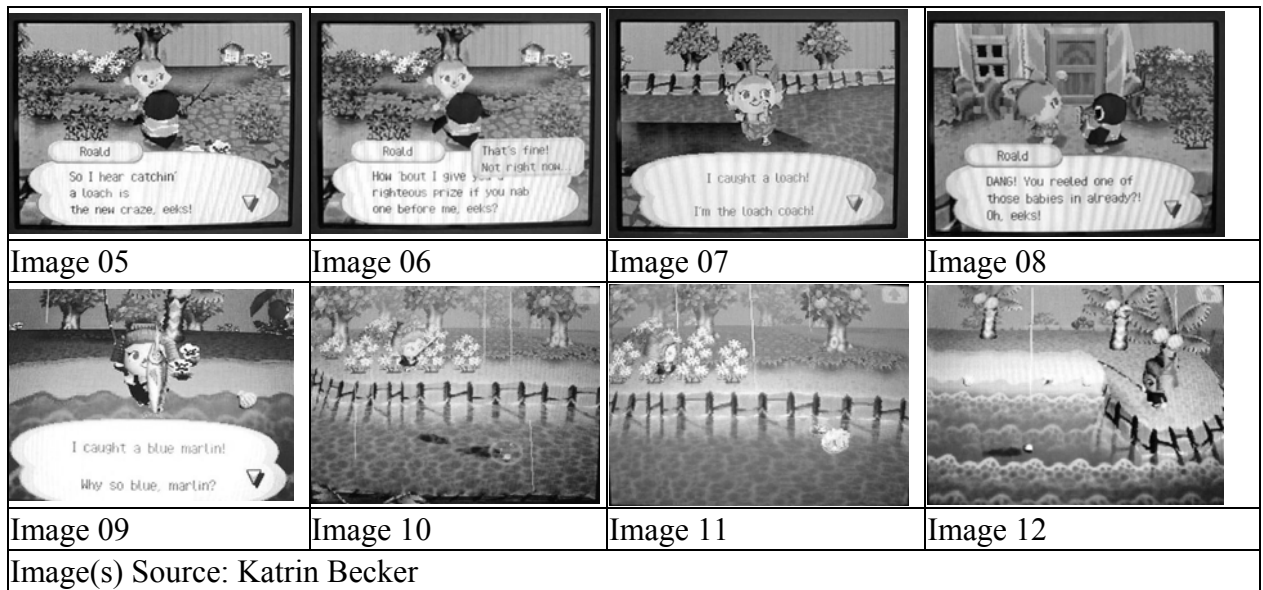
In order to take up the fishing theme the player must first purchase a fishing rod from Tom's Store. This is one of several tools that can be purchased. Players are introduced to this notion at the start of the game when they are required to deliver a watering can to one of the residents who then tells them how it can be used. Once the player has caught at least one of every kind of fish available, she is rewarded with a golden fishing rod. Fish caught can be sold to Tom to raise money or they can be donated to the museum and become part of its collection (Figure 7.6 Image 02). The museum will only accept one of each kind.

A fishing 'event' typically begins when the player sees a fish silhouette in the water (Figure 7.6 Image 10) and has the fishing rod in hand. If the player doesn't have the rod in hand, but is carrying it in her suitcase, she can easily get hold of it without loosing an opportunity to catch the fish as the fish will stay visible for some time (unless the player causes the avatar to run, which has the effect of 'scaring the fish' and making them disappear). With rod in hand, the player must position the avatar appropriately (which takes practice) and cast the bobber (by tapping the player's head or pressing 'A'). The fish

move around somewhat randomly and sometimes change direction so there is no guarantee that casting the line will attract the fish. In fact, the lure must be within the fish's 'line of sight' (if, indeed the fish could see), and also relatively close in order to attract the fish's attention. Once the fish has started to move towards the lure (Figure 7.6 Image 12), the player must not remove it, or the fish will disappear. The fish will move closer to the lure and eventually cause the bobber to bob (Figure 7.6 Image 10). After a random number of bobs (0-6) the bobber will submerge and the player can hear a sound like that of a bobber being submerged and popping back up (Figure 7.6 Image 11). Timing is important at this time as the player must quickly pull up the line (by tapping the avatar's head or typing 'A'). If the timing is not right, the fish will disappear. Occasionally, the fish will disappear in any case but not very often. Once caught, the avatar will show off the fish, identify it, and make some sort of remark or pun (Figure 7.6 Image 09). Finally, the fish is added to the avatar's inventory, where it will stay until the player decides to move it.

A fishing 'bout' would involve numerous fishing events which end when the player decides to do so. There are a limited number of spaces in the avatar's 'pockets' so if it is a lengthy bout the avatars pockets may all become full and if the player continues to catch fish, she must then decide whether she wants to release the most recent catch, or swap it for a different one, which will be released in it's place.

As was stated previously, the player can donate one of every species to the Museum which is maintained as a separate collection from the one maintained by the avatar herself (Figure 7.6 Image 01). Simply catching a fish of a particular type will register that fish in the player's collection. Aside from giving fish to the museum, they

can also be sold at Tom's Store, but unlike furniture or flowers, they cannot be left in the recycle bin or attached to letters as gifts. It is certainly possible for a fishing bout to last for several hours (real time) if the player continues to sell or release the fish caught, and in fact the author did this as she was attempting to finish her collection. The reward given to the player when at least one of every fish has been caught is a golden fishing rod which ironically makes it easier to catch fish.

Addressing Tinbergen's Four Questions with respect to Fishing

Individual events and steps can be analysed using the four questions, but in the initial stages of an investigation it is more productive to examine sets of behaviours and bouts as groups. The ultimate goal in this context is to gain insights into how we might design games for learning, so always the principal guiding question is, "How might this design be adapted or used to support educational objectives?"

Interaction (proximate causation, or control) How does it work?

The various aspects of fishing behaviours are triggered by different auditory and visual stimuli, so for example the 'snag the fish' step is triggered by a specific sound and the 'try to catch a fish' event is triggered by the presence of a fish silhouette in the water. The larger event that includes searching for a silhouette along the water could be triggered either by the player herself, or as a response to a challenge issued by one of the NPCs (Figure 7.6 Image 06).

Game Ontogeny (development, externally driven behaviours - game flow, or in the more general case: program flow) How did/does it develop?

The fishing behaviours do not change over the course of the game, however, the player's skill is likely to change resulting in more efficient results for the player. Many fish have specific times of day, locations, or seasons when they can be caught, but that is a direct function of the calendar rather than development in the game. The game does have increasingly demanding levels of achievement for some things like mortgages, but this is not the case with fishing.

Classification (evolution; phylogeny) How did it evolve?

This question does not have a straightforward answer, as it necessitates a comprehensive analysis of many games that are related or similar to *ACWW*, and at this early stage in the use of this methodology as well as for the current work, it was decided that this work would not yield sufficient results to warrant the extra effort. Once players become proficient at this behaviour it becomes a reliable means of earning bells, not unlike 'mining' behaviours found in many online games.

Function / Purpose (survival value - function) What is it for?

Fishing in *ACWW* offers a reliable source of income so provides a means of allowing the player to engage in other activities as well. It also interconnects with other activities, such as building relationships with NPCs.

Gardening

Figure 7.7 Animal Crossing Wild World Gardening Screenshots

Image 01	Image 02	Image 03
Image 04	Image 05	Image 06
Image 07	Image 08	Image 09
Image(s) Source: Katrin Becker		
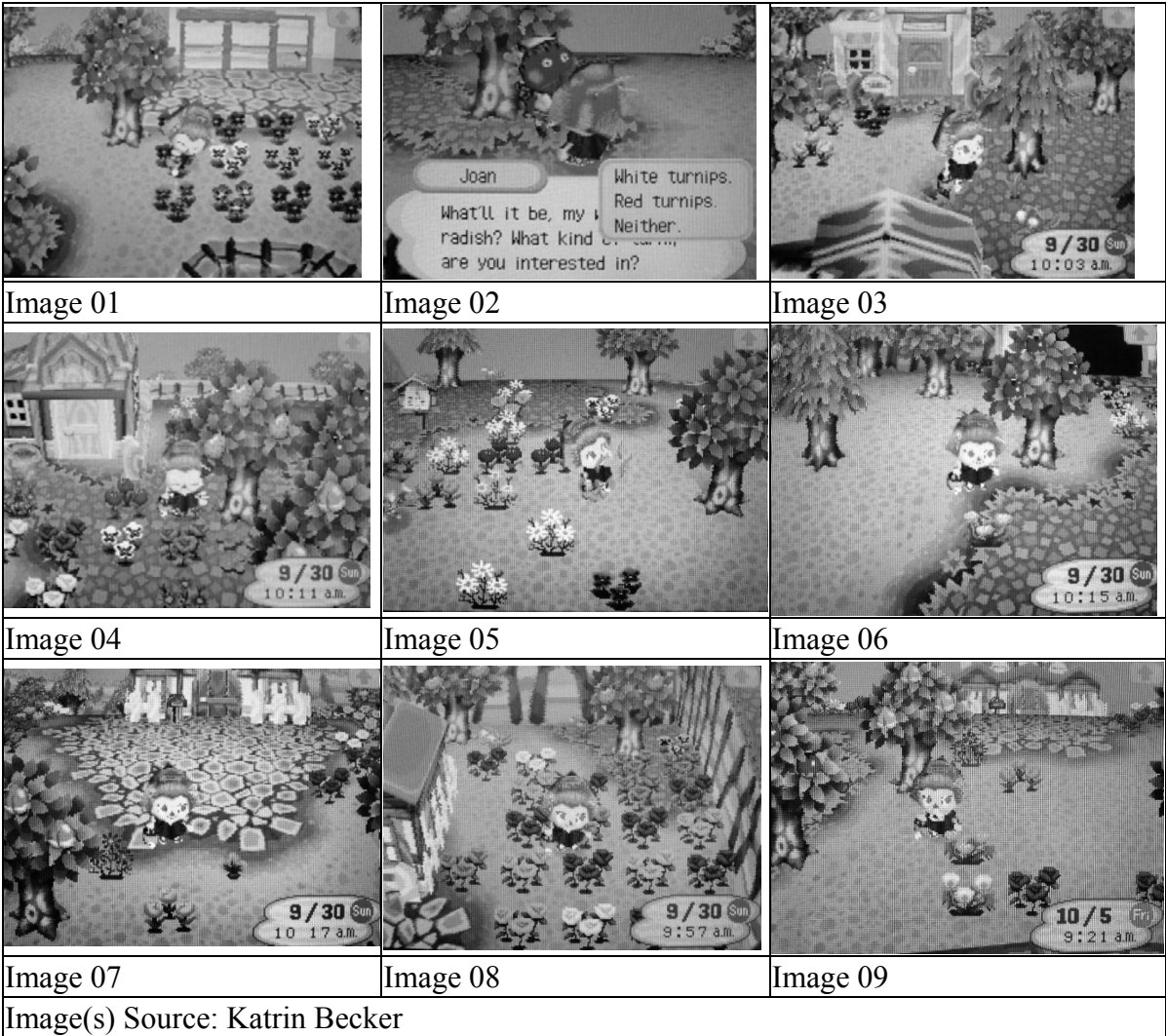
Gardening includes a much more varied set of behaviours than fishing does and

similar gardening behaviours can be used to advance different goals. Ultimately almost

all behaviours in *ACWW* are designed to contribute to collections or build wealth. Given

that those are the two primary objectives in this game, gardening is an activity that does

not really fit the pattern well. Flowers are not valuable as commodities, except for turnips

which are used as a sort of 'stalk market' (pun intended) and can only be purchased from

Joan who appears once each week (Figure 7.7 Image 02). Turnips come in two varieties:

red and white - white ones are not planted but saved to be sold back to Tom at the store

when the price is right. Red turnips are planted and will appreciate quickly, but need daily watering (Figure 7.7 Image 07). Both are volatile and will easily become rotten. Regular flowers can be purchased at the store and come in four varieties, each in three colours. They contribute to the status of the environment when planted in sufficient numbers. If the environment contains sufficient trees and flowers players are rewarded first with the appearance of Jacob's Ladders in random locations (Figure 7.7 Image 03), and if the environment is maintained for several weeks consistently they are rewarded with a golden watering can. Flowers can appear spontaneously from time to time, but all will sooner or later turn brown and must be watered or they will disappear. A single watering during the day that the flower has turned brown will revive it, and no watering is necessary on a day that it rains. Players can find this out from the NPCs which will tell them. Certain colour combinations will also result in the spontaneous appearance of new colours (Figure 7.7 Image 01 & 05) that cannot be purchased which are more valuable than their more common counterparts. The ultimate rewards for 'flower breeding' is a golden rose, which appears in place of a rare black rose once the black rose has turned brown and is watered.

Flowers can be pulled and replanted at will, provided they are not brown, but they cannot be dug up with the shovel as it destroys them. They will not be damaged when the avatar walks over them but are destroyed if the avatar runs over them.

It is not possible to buy and plant sufficient numbers of flowers to create a high scoring environment so gardening is necessary if players wish to earn the golden watering can. In addition to planting and tending flowers, weeds (Figure 7.7 Image 03) will also appear that must be pulled (Figure 7.7 Image 05) as they detract from the score.

Three weeds appear daily as well as seasonal dandelions (which eventually turn to dandelion puffs that cannot be revived) and clovers. Every now and then one of the clovers will be of the four leaved kind (not obvious when the plant is still in the ground) which is valuable and can be sold or given to other NPCs. One impact of the regular appearance of weeds is that it becomes impossible to 'time-travel' (set the game clock) forward more than a day or two without incurring a severe infestation of weeds. This in turn has the effect of causing NPCs to move out, thus ruining the player's chances of collecting their pictures (the ultimate reward for maintaining a good relationship with an NPC).

As with the fishing behaviours, much of what needs to be learned about gardening is learned through discovery, as well as through 'conversations' with NPCs that provide information in the form of hints, guidance, and occasional contests (there is an annual flower contest). The rewards are simple but clearly connected to the actions taken, and penalties are neither severe nor unrecoverable. In other words, players can keep trying until they achieve the goal they have set, and if they mess it up they can simply keep trying. Each milestone is small enough that success seems guaranteed.

Addressing Tinbergen's Four Questions with respect to Gardening

Interaction (proximate causation, or control) How does it work?

Most of the interaction triggers are visual ones (flowers go brown and weeds appear), and the internal causes are statistically controlled, provided the player has set up the appropriate conditions. Thus planting the right colours of the same kind of flower in the right configuration is necessary for new colours to appear, but is no guarantee - new

colours do not appear often, and some colours and flowers are easier to 'breed' than others. Over time and through repetition, players learn the rhythms of the game.

Game Ontogeny (development, externally driven behaviours - game flow, or in the more general case: program flow) How did/does it develop?

As with most other aspects of the game, the actual behaviour of the game does not change, even though the environment changes over time. The changes in the flowers are connected to the interaction of the player giving a sense of control.

Classification (evolution; phylogeny) How did it evolve?

Another game that is related though different gardening behaviours is *Harvest Moon* which is also a popular game now with more than a dozen versions.

Function / Purpose (survival value - function) What is it for?

Gardening serves several purposes in *ACWW*. It contributes to the cyclical, seasonal context of the game. It helps to ensure the 'survival of the game' by providing rewards for tending, which for many people has the effect of drawing them back to the game on a regular basis - those flowers need daily attention.

What Was Learned and How It Was Learned

Players learn many things in this game that help them to achieve the goals they set for themselves. For example, through practice players learn various skills such as fishing and bug catching. They learn about flower tending largely from comments made by NPCs, and to some extent through experience. This is a game designed to be played along side real time so there are few time pressures and few serious consequences. The game supports exploration by providing a pleasant environment over which players have

considerable control, and by rewarding the player with both predictable and surprise rewards. The interface is simple, and only viable options are presented when a user must make a choice. 'Illegal' moves such as trying to place a furniture item in a room that is already full causes a dialogue bubble to appear telling the user that the room is full.

ACWW is designed to allow almost perpetual play and so on the surface it might seem that such a design would be unsuited to informing design for formal educational settings, but its simplicity, both visually and interactively has provided useful insights. The next game is similarly simple both in terms of graphic sophistication and interactivity, yet it also proved informative.

Katamari Damacy

Katamari Damacy is a game with a very distinct objective: to repopulate the sky with stars. This is to be accomplished by going to Earth and rolling up various man-made and other items using a katamari. Like *ACWW*, it too has a tutorial at the start that cannot be avoided. This game begins with a brief back-story, as do many games, which sets the premise for the gameplay that follows. The story is expanded a little later in the game and also provides the support for segues between levels. The basic controls for each level involve only the left and right analog sticks, which are used to roll the katamari. At the start of the game players are led through a tutorial mode, where each distinct move sequence must be demonstrated before the player is allowed to progress. Although the game cannot ensure that players remember the moves, it can make sure that players have practiced each one (Becker, 2007i). Given that the controls for this game are very simple, the bulk of what needs to be learned has to do with strategy.

First Grasp

The game includes only two main characters: the King of All Cosmos, and his son, the Prince. The player is the Prince, who happens to be no more than two inches tall. The game space is divided in to three main parts: the home planet which contains the game options as well as access to the various play levels and data about collections, a space mushroom which is where the two player mode data is kept, and the Earth, which is where the levels are played.

The author found the musical score for this game to be light-hearted and quite distinctive. It certainly helped to set the mood which was one of frivolity and it matched the general silliness of the game itself. Each course is relatively short but it was easy to become absorbed in the activity as it took a considerable amount of concentration.

Players begin to practice moving almost immediately and it does not take long before they are ready to begin the first level. In this game much of what is learned is learned through practice. Table 7.2 shows an excerpt of the data collected by the author during unstructured play.

Table 7.2 What I Learned in Katamari Damacy	
What I learned	**How I Learned It**
the back story doesn't need to be first	here we get a brief intro to the two main characters, then we go through orientation, THEN we get the backstory. The King of all Cosmos broke the sky, and now the prince must return the stars.
as I get bigger I am more likely to get stuck in places.	experience, observation
There are strategies to be learned - without them you can't get through the levels after the first few.	Repetition (drill?) After going through a course many times I begin to get a picture of the space and where the better 'stashes' of stuff are.
Some items are worth more than	experience

others, and some are dangerous (cause me to get thrown around)	
some items must be avoided while the katamari is small. If I hit them I can get thrown about and loose bits.	observation - the counter measures the size of the katamari
If an animal is unafraid, I cannot roll it. Once it becomes afraid of my katamari and tries to escape, I can roll it.	experience

Inspection of Detail

This is one of many games designed and develeoped in Japan. While the cultural perspective of the game's design clearly affects the 'personality' of the King, functionally it does not impact on the game's behaviour. The King offers little verbal encouragement, even when levels are completed well within the limits and provides ample criticism when levels are missed. However, levels can be attempted as often as desired with no consequences for failure – failure to complete a level does not adversely affect other parts of the game. The comments by the king offer little in the way of positive reinforcement, but as they do not affect the function of the game, they can be ignored. Thus, from an instructional ethology perspective, the king's comments are irrelevant for some, while others report that they enjoy striving for the King's rare compliments as part of their gameplay.

Figure 7.8 Katamari Damacy	Figure 7.9 Katamari	Figure 7.10 Katamari
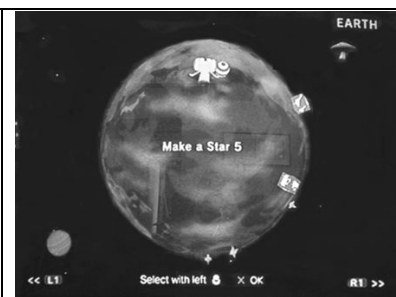
Tutorial	Damacy Main Menu	Damacy Level Menu
Figure 7.11 Katamari Damacy Level Completion	**Figure 7.12 Katamari Damacy Star 5 start**	**Figure 7.13 Katamari Damacy Star 5 end**
Image(s) Source: Katrin Becker		

Addressing Tinbergen's Four Questions in Katamari Damacy

Interaction (proximate causation, or control) How does it work?

During a course, almost the only object in the game over which the player has any control is the prince, and aside from jumping over katamari for a quick change in direction, the only thing the prince can do is roll the katamari - backwards, forwards, left, right, fast and slow. The player may view the course from various vantage points (including high above the surface) but during this time the prince and the katamari are stationary.

Game Ontogeny (development, externally driven behaviours - game flow, or in the more general case: program flow) How did/does it develop?

The play levels themselves are all on Earth, and each is a surrealistic but recognizable representation of some physical space, such as a house or town. The level of detail visible is directly connected to the size of the katamari. The overall structure is

relatively minimalist in the sense that virtually all items are directly relevant to the game – there are few distractions and all items appear to be usable in the game (Becker, 2007i).

The game's behaviour changes both as the player progresses through the levels and as the player progresses through each level. During a single course, the point of view changes from very small to very large, which is connected to the size of the katamari. Small items are no longer visible when the katamari is large, and objects that initially acted as obstacles become candidates for rolling. As is typical in level progression, the requirements increase as the levels do and both the target size of the katamari increases as well as a decrease in the relative amount of time allotted to complete the task.

Classification (evolution; phylogeny) How did it evolve?

Classification of this game is more of a challenge than most, and the identified genre of this game is often listed as novelty, or miscellaneous. In terms of behaviour, it could be classified as a puzzle game, and as such compares to other classics like *Tetris*. When examined in this light, it can be seen that both structurally and behaviourally, puzzle games like *Katamari Damacy*, *Tetris*, *Brain Age* and others have much in common (Becker, 2007i). The 'simple to learn but hard to master' philosophy of this game's design puts it in the company of many classic games like the board game GO. In digital games, its simple interface and rules also put it good company with games like the *Mario* franchise. These are all games where it relatively easy to get started playing, but becoming accomplished takes a great deal of practice.

Function / Purpose (survival value - function) What is it for?

The entities in this game that provide instructional support include the game space, which has significant conceptual coherence. That is to say that all game options and play levels are accessible from the Prince's home planet , and each location on this planet serves a distinct function. Conceptual coherence of the visible elements is important to the usability of any software application, and games are no exception. Instructionally, conceptual coherence plays an important role in situated learning and provides the context for what is to be learned. Thus the aspects of this game's structural design that support learning are instructionally sound.

Assessment is an essential support for learning as it provides the feedback necessary to allow learners to track their progress and this aspect is addressed through the game's displays. In *Katamari Damacy*, display or feedback elements are similarly well integrated into the game space. For example 'scores' for completed levels are represented as stars in the Cosmos, but the player may repeat a level at any time and upon completion of the repeated level has the option of replacing the 'old score' (in the form of a star in the sky) with the new one or simply keeping the old, in which case the new katamari becomes stardust. Each accessible level is represented as an object on the Prince's home planet. During a course (rolling a katamari) the display always shows the time remaining as well as a pictorial clock dial, the current diameter of the katamari as well as the target size (again, both numerically and pictorially), and each time an object is rolled, it is identified and its size is displayed. Constantly updated feedback in the game is a behaviour that helps the player track the effectiveness of various strategies and thus helping the player succeed. There are also warnings about potential hazards. Here again the game provides both guidance and feedback that is consistent and concise.

<u>What Was Learned and How It Was Learned</u>

Much of what is learned in this game comes either through being told by the King, or through experience and repetition. The design of this game follows many of Gee's principles (Gee, 2003), particularly 6 ("Psychosocial Moratorium" Principle), 12 (Practice Principle), 26 (Bottom-Up Basic Skills Principle), and 28 (Discovery Principle) (see Table 3.1 Gee's 36 Principles). This game has few actors, and few locations but plenty of challenge and given that all courses have time limits, players learn to strategize in order to maximize their gains. In that way it could even be compared with someone who continues to play golf at the same course, repeating each hole trying to achieve perfection, or at least improve upon their previous best score.

The first two games were quite different in many respects such as that *Katamari Damacy* had distinct levels and *ACWW* did not; *ACWW* allows players to choose their goals and *Katamari Damacy* did not (at least not within any given level).They both had a high degree of conceptual coherence and proved access to standard elements such as inventories and 'scores' within the context of the game world. The next section examines the third game, *Black & White* using the same approaches, followed by a general comparison.

Black & White

The author spent the least amount of time playing *Black & White* but of the three games examined, it is the one where the player has the most to learn. The player does not have an avatar in the game, instead, the player controls a hand that can move objects and interact with the villagers as well as with a creature that the player may choose,

essentially as a pet and emissary. This creature is designed with relatively sophisticated artificial intelligence making it quite unpredictable at times. The player can train the creature to react in certain ways, but one of the aspects that has made this game so popular is the unpredictable nature of this game. One claim tells of a player's cow creature being taught to heal sick villagers, but after being neglected by the player for too long, it began to hurl villagers against the wall. Having done so, it could then heal them and through the villagers' gratitude, receive the attention it craved. This game was designed to present the player with ethical dilemmas that could be explored, and offers a rich environment for doing so.

First Grasp

The initial sessions of this game are typically spent becoming familiar with the geography of the island, and learning about the needs of the villagers. This is done through signs that are posted in various locations and can be read and reread at will, as well as occasional visits from Red and White, who often appear together (one to inspire 'good' acts and the other to inspire selfish or detrimental behaviour). Red and White may also appear to inform the player of some impending danger or thing that needs attention - such as villagers who are starving and need food. Unlike *ACWW*, players are not especially free to wander around and explore unless of course they have completed their 'chores' which include such things as making sure the villagers have sufficient food and building materials. Although Red and White appear fairly often to talk to the player and there are plenty of helpful signs all around, the player is still left to discover many things through experience and practice. This, like many games that require strategy are intended

to provide many hours of gameplay so the fact that players do not learn all they need to play the game at the beginning is an intentional design.

Table 7.3 What I Learned in Black & White	
What I learned	**How I Learned It**
villagers stay where I put them, more or less	experience: If I put a villager in a field, they begin to tend it; if I put a villager in the temple they become worshipers.
the Creature learns through praise	If I stroke the Creature after it does something, it is more likely to do that again
villagers will starve and die if I don't feed them	observation

Inspection of Detail

Black & White was studied less extensively than *ACWW* and as a result the inspection of detail is described at a higher level of abstraction, describing the game behaviour as a whole rather than through individual events or themes.

Addressing Tinbergen's Four Questions in Black & White

Interaction (proximate causation, or control) How does it work?

Alessi & Trollip (2001) suggest including an instruction booklet with a game, and though most games do come with instruction booklets, it is widely known that players rarely look at them before starting to play. In the case of *Black & White* the hard-copy instruction booklet that ships with the game is of a similar type to those for other games: it provides a brief introduction and overview including information on the controls and environment, main features of game play and the characters. An additional manual is provided on the CD which provides additional information.

Behaviour in this game and therefore the proximate causation is highly complex due to the AI qualities which were built in to both the Creature and the villagers

([Molyneux, 2003](#)). The NPCs are designed to learn and change as the game proceeds and the appearance of the Creature reflects its state. As time goes on the Creature especially becomes more likely to act spontaneously and its reaction to player behaviour is dependent upon its stage of development and whether it is becoming good or evil.

Game Ontogeny (development, externally driven behaviours - game flow, or in the more general case: program flow) How did/does it develop?

The development of this game represents a far richer and more complex phenomena than either of the other two games. This aspect of the game's behaviour is also a result of its complex Artificial Intelligence. At the start of the game the villagers are very naive and appear to wander about rather aimlessly don't seem to notice when they become hungry. The player's guiding hand must show them such things as where the gardens and fields are and how to tend the animals. Over time, the villagers become more organized and begin to act more autonomously. The Creature begins as a juvenile and is also naive. It must be trained by the player and will grow and develop according to how it has been raised (see [Figure 7.8](#) - [7.13](#)). There are also communities outside of the player's village which may come and attack requiring some sort of defense. Villagers can starve and die without the proper care, and the Creature can get into trouble and cause mischief if left alone too long and if not properly trained.

Figure 7.8 Black & White Juvenile Cow	**Figure 7.9 Black & White Adult Cow**	**Figure 7.10 Black & White Good Cow (1)**
Figure 7.11 Black & White Good Cow (2)	**Figure 7.12 Black & White Siege Cow**	**Figure 7.13 Black & White Evil Cow**
Image(s) Source: Lionhead Studios http://www.lionhead.co/bw/		

Classification (evolution; phylogeny) How did it evolve?

The evolution of this game primarily goes back to previous games by the same designer (Peter Molyneux) who is often credited with the development of the god-game genre, which began with *Populous*. When the ethically-influenced character development is considered, *Black & White* was itself succeeded by *Fable*, and there are more to be released soon.

Function / Purpose (survival value - function) What is it for?

This game offers a great deal of in-game support through the 'Spiritual Advisors' (Red & White), the villagers, various pop-up scrolls, an Animal Trainer, and information available in the player's Temple (once it is built). Players need not guess at how things work, but must usually seek help explicitly. The rest is left to experience and practice.

What Was Learned and How It Was Learned

Some time ago, I was in my young son's room (he was about 10 at the time) watching him try to explain this game to his older sister as he was playing it. On screen could be seen a single villager wandering about near a cliff and my daughter asked what would happen if my son 'flicked' the villager over the cliff. My son said he didn't want to do that, but older sisters (and meddling moms) being what they are, we both encouraged him to try it and see. Finally he recanted, saying he would do it this once, but he didn't want to do it too often because if he did his Creature would go bad and it would then do far more damage. In this game, the Creature in effect becomes the manifestation of the player's actions - if the player's actions are moral and kind, the Creature becomes benevolent and helpful, but if the player's actions are malicious or inconsiderate the Creature becomes monstrous.

In addition to the typical in-game skills and strategies learned in most games, players of *Black & White* are taught moral lessons through the reactions and development of the villagers and the Creature. One example is that excess can have negative effects even if one's intentions are good. If players feed their villagers too well, they reproduce in large numbers, which means they will need more land, new buildings, more farmers & crops, and so on, all of which require micromanaging by the player. Eventually, the player will have time for nothing other than maintaining the villagers - leaving the Creature to be neglected, and, ultimately diminishing the richness of the play experience.

General Results

Global Inspection

These games all share several characteristics. A key one is that all activities within the game are connected to the overall form, so all activities in *ACWW* relate to "life in the town"; all activities in *Katamary Damacy* relate to repopulating the sky for the king, and all activities in *Black & White* relate to managing the villagers and one's creature. However far-fetched the narrative may be, the good games have high conceptual coherence to that narrative along with a high degree of consistency with respect to how scores are kept, how inventories are maintained, how information is stored and displayed, and how progress is tracked through the game. Another critically important characteristic is that players always have access to information about their own progress, and in cases where a distinct endpoint can be achieved, the player's distance from that endpoint is also easily discernible. A third characteristic that all three of these games shared and neither of the two rejected games had was a mandatory tutorial. The tutorial was unavoidable in

the three games studied, though it was short and focused on those essential elements players would need to get started. They did not provide a complete overview - in all cases there were more things to be learned which would be presented to the player, sometimes at random (as in *ACWW*), sometimes at the start of a new level (as in *Katamary Damacy*), and sometimes immediately before it was needed or in response to some related action (as in *Black & White*).

Addressing Tinbergen's Four Questions Overall

Interaction (proximate causation, or control) How does it work?

Katamary Damacy was the simplest of the three in terms of interaction, and *Black & White* was the most complex, with *ACWW* falling somewhere in between. The same is also true for the number of characters involved, yet the potential for number of hours of gameplay is not similarly related, though all three are designed to let the player become active as quickly as possible.

Game Ontogeny (development, externally driven behaviours - game flow, or in the more general case: program flow) How did/does it develop?

The three games approached some things quite differently: the only one with a fairly typical level design is *Katamary Damacy*. *ACWW* does not have obvious levels; instead it has different rewards associated with various levels of achievement which are measured and assessed separately. Some refer to the different mortgages as levels, but since the only thing that changes when one mortgage is paid off is the size of the player's house it really doesn't qualify. *Black & White* also has no discernible levels but it does offer quests through presented via the scrolls which the player can choose to ignore or

take, though it is made clear that taking up quests will usually lead to additional information players can use.

Classification (evolution; phylogeny) How did it evolve?

Each game has predecessor games in that each game bears resemblances to older games of similar styles and genres, yet each has unique qualities. The sustained and overwhelming popularity of these games is testament to the success of their designs.

Function / Purpose (survival value - function) What is it for?

Learning support in all three games is a well-balanced combination of experience, advice, and practice. Players can always choose to ignore the advice and other offers of help, but it will inevitably result in players having little to do in the game other than repeating past accomplishments and wandering about the gamespace. Even for the most dedicated of players, this becomes boring eventually, and they will turn to the offered advice to find something new to try, experience, or achieve.

Finally

Of the three games studied, *Black & White* is the only one with any real educational potential and it could be an inspiring focal point around which many interesting and productive conversations could be had about ethics and good citizenship. It is also the most complex game of the three, though the other still offer much that can be learned, however 'useless' it may be. For example, game guides for *ACWW* typically run around 50+ pages (Eagleson, 2005) and some are over 200 pages (Wolfram, 2007) of almost exclusively text. Clearly, there is much that can be learned in *ACWW*.

Towards Deeper Understanding

Instructional Ethology is intended for analysis of finished or at least playable games. This is not intended as a means to assess an initial design. It is clear from the initial analyses that the greater the body of data that can be collected the richer the results will be. Part of the value of taking an ethological approach to the analysis of games will come from an ability to compare results between games. Some, like *Black & White* are complex enough on their own to provide rich volumes of behavioural data, and other games with complex Artificial Intelligence (AI) systems will also be able to offer rich descriptions. Typically, these games are designed to provide many hours of play so their overall design is not likely to be as applicable to educational game design as the short form game. Still, much can be learned about how games support players while they learn the game and though the overall design may not be easily appropriated for educational aims, aspects of its design will certainly be.

CHAPTER 8 SCHOLARS IN A RAGE: IMPLICATIONS FOR

INSTRUCTIONAL DESIGN AND LEARNING

One learns more from a good scholar in a rage than from a
score of lucid and laborious drudges. *- Rudyard Kipling*

What implications do the new connections, approaches, and insights have for the

design of games intended primarily to teach? One is that no single Instructional Design

model is going to be able to address how to build educational games, and if we heed the

lessons that can be learned from thirty-odd years of Software Engineering (Hayes, 2003)

and that of Instructional Design (Kenny, Zhang, Schwier, & Campbell, 2005), no model

or theory will be forthcoming that can serve as anything but a guide. In other words, there

will be no reliable recipes for designing and developing educational games. However, the

current research has resulted in several new insights and principles that apply directly to

the design of educational games and of commercial games used in educational contexts.

What We Already Know

Conclusions drawn from several major literature reviews indicate that games have

a place in educational technology. The following list contains a summary of the major

findings.

- There is potential for learners to become more empowered with game-based
  learning (de Freitas, 2007; Kirriemuir & McFarlane, 2004).

- Game-based learning presents new opportunities for re-considering how we learn
  (de Freitas, 2007).

- Collaboration, communication, teamwork, lateral thinking and problem-solving
  are part of both the learning and the playing experience of digital games (Ellis,
  Heppell, Kirriemuir, Krotoski, and McFarlane, 2006).

- Adapting COTS games to suit the context of the classroom is very time consuming, and is a primary challenge (Ellis, Heppell, Kirriemuir, Krotoski, and McFarlane, 2006).

- Student motivation was positively affected by the use of familiar games and through having some autonomy when playing (Sandford, Ulicsak, Facer, & Rudd, 2006).

- Fixed-length lessons were constraining (Sandford, Ulicsak, Facer, & Rudd, 2006).

- Games did not need to be highly accurate to be beneficial (Sandford, Ulicsak, Facer, & Rudd, 2006).

- Meaningful use of games "within lessons depended far more on the teacher's effective use of existing skills than it did on the development of any new, game-related skills." (Sandford, Ulicsak, Facer, & Rudd, 2006, p.4).

Although this can be seen as quite encouraging, it must still be seen in context. Most of the findings have been reported by those who are either already using games in the classroom in one form or another, or those who would be willing to use games. It has also been reported that although use of games has been increasing over the last few years, it is still not widespread (Ellis, Heppell, Kirriemuir, Krotoski, and McFarlane, 2006). There is still a long way to go and much to be learned before games can be designed and used in the classroom with the same confidence and acceptance as other media.

Towards a Theory of Learning through Games

If we accept that games have potential as instructional technology but that we will not likely find a one-size fits-all design model perhaps we can at least propose a theory of learning through games. Gee (2003) has offered 36 principles for how games help players learn though it is not clear whether all games must implement all 36 principles, or if some

principles may be better suited to some kinds of games (and learning goals). Prensky offers suggestions for which kinds of games are suited to what kinds of learning (2001d) but though he does provide many anecdotes and information on who is using games in learning contexts (Prensky, 2006), there is still very little data to verify these connections. Several scholars have aligned learning with games with Activity Theory as a way to understand and analyse learning in games (Squire, 2002; Hadziomerovic & Biddle, 2006). In this view, games can be seen as the activity system that acts as the mediating artifact (Dobson, Ha, Mulligan & Ciavarro, 2005 ; Pelletier & Oliver, 2006). Richard Van Eck (2008) suggests that games use Play Theory, Situated Cognition, Scaffolding, Problem-Based Learning and a number of others, and Garris, Ahlers & Driskell (2002) offer their own game learning model that is a form of information processing model. More recently, Clark Quinn proposed a model that aligns elements of learning with engagement (2005), and David Shaffer describes a theory of learning using games he calls Epistemic Games - those that put the player in a role where they learn to act and think like a professional and he provides several case studies of such games (Shaffer, 2006) but does not describe a design theory or model that can be used by others to build such games.

The kind of designs necessary to make a commercial game into a top-rated success include many strategies intended to motivate players to keep playing, and although this is a highly desirable situation for games used for learning in formal situations, it does not carry the same weight in education as it does in entertainment. It would hardly be controversial to claim that many of the projects, literature, and other exercises learners are compelled to complete in school are completed to meet external

demands or powered by extrinsic motivators rather than a pure desire to learn. This is not necessarily always a bad thing, though the design and development of games for learning are such complex undertakings that building one is not justifiable unless there is good reason to believe the resultant intervention will be at least as effective as more traditional approaches, and preferably more effective.

People learn through games for many of the reasons that have been outlined by other scholars: games provide a safe place to practice, they offer opportunities to play out roles that would not be possible in real life (because the actual experience would be impractical, exclusive, expensive, dangerous, etc.) and to try out scenarios that would not be possible in real life, among other things. Ultimately, learning often happens in games in ways comparable to how learning happens in situated, experiential contexts. The word 'often' is used here because there are many kinds of games from very simple to very complex and different kinds of learning are likely to be facilitated by different kinds of games. However, even though a game may have all the qualities deemed important in a game, it may still be a poorly designed game and unsuccessful in meeting its objectives, just as a novel can possess all the right pieces in all the right proportions and still be a boring book.

One aspect that sets the medium of the videogame apart from other media is its highly interactive nature - people learn in games by doing things, and this experiential quality lies at the core of game design. Games provide an experience - and games designed for learning can do no less. Any epistemology of games must begin with the experience.

Epistemology of Games

The observations made of the games examined in the present study were approached from two distinct perspectives: first from an informal perspective ("First Grasp") and then from a more structured ethological perspective ("Inspection of Detail"). Insights gained from specific games are described as well.

In the first case using informal observation, the guiding questions drove the data gathering. They were: "What must be learned in order to get through the game?", and "How does the game support that learning?". Observations were recorded only when something was identified as having been learned, and in most cases it was some knowledge or skill that was needed to achieve the stated goals. Readers are reminded that the efficacy of the learning support strategy is not being assessed in this study, only its existence. Implications of this approach include the possibility that things learned by the author would not be commonly learned by others (although the author's status as a rank novice gamer plays an important role here), and that things will be missed. In its defense, this can also be said of virtually any small-scale user testing. Any approach that is not exhaustive will inevitably leave things out.

In the second case using a more formal approach, observations were made and then analysed after the fact for connections to learning support strategies. Just as in traditional ethological fieldwork, there is no guarantee that recorded observations will yield insights. However, in the case of this research, several insights emerged from the analysis.

Outcomes from Informal Observation

The informal analysis of the games sought to discover what needed to be learned in order to succeed in the game and then to examine the mechanisms that support that learning. It is known that not all learning in a game is necessary to win and also that sometimes learning occurs that was never intended by the designers. Five categories became apparent and it is proposed here that all learning in and around games can be classified as (non-exclusive) members of at least one of these sets. The author designed several visualizations of the relationships of these five sets, and the final image ended up being somewhat bullet-shaped (see Figure 8.1) and thus earned the moniker "Magic Bullet". The five categories are named below and described in more detail in the next section.

1. Things we CAN learn in the game (as deliberately designed by those who created the game).

2. Things we MUST learn in a game (will always be a subset of the first category).

3. Collateral Learning (other things we can learn - these are not necessarily designed into the game, although sometimes designers may hope that players choose to take these up).

4. Things we actually DID learn ("your results may vary").

5. Cheats - One could argue whether or not this should be seen as a category distinct from Things-We-CAN-Learn. Cheats are typically designed into the game for testing purposes, and often left in the game once it ships. So, they are deliberate design elements on the part of the designers, but not really considered part of the normal gameplay. [Note: some game designers may consciously put the cheats

into play by assuming people will use them and designing accordingly but they are rarely, if ever, *required*, so they are not part of what we MUST learn.

The Magic Bullet

Things We MUST learn

The elements in this category may vary depending upon the game. Some games allow multiple paths to the win; some games have multiple win states; some have various goals that can be pursued without any single win state.

These things are essential to winning the game in some way. In something like *Phoenix Wright*, there is really only one path to the win so all players must learn the same things (in this game they must do so in pretty much the same order too - it is essentially a game on rails) but many games have multiple paths to the win and/ multiple win states. *ACWW* doesn't have an actual win state, but allows you to set various goals, like paying off all of your mortgages. If there are multiple win states or multiple paths to the win, then the set of things a player MUST learn can vary and two different players learn somewhat (or radically) different things. Often though at least some of those things will overlap. The nature of the MUST-Learn set depends on the path or endgame the player is trying to achieve. With multiple paths to a single win it is possible for two players to learn different things and each still be able to win.

The more one MUST learn of the total set, the fewer choices players ultimately have. If there is not enough we MUST learn in order to win, there will be insufficient challenge.

Verification: The MUST learn category is verifiable by asking the designers. They are the ones who make the game rules and determine what is needed to win, so the designers are the ones who say what is included here.

Things We CAN learn

The CAN learn category is intended to include only those things that were designed into the game. This could also include the cheats that have been left in the game, but it was decided to separate cheats into their own category because they need to be treated separately, especially in educational contexts. These are all the things the designers put in there on purpose and includes both minor and major objectives. For [Animal Crossing Wild World](#) for example, it includes major things like: how to make money (bells), how to fish, how to make and keep friends, how to collect various things, etc. It also includes minor things like the fact that flowers don't need to be watered on rainy days, and that you can walk over a flower safely without damaging it, but running over it will destroy it. There's lots there we CAN learn. That's the part of the pictures shaded with light horizontal lines (see Pattern Codes at [Figure 8.7](#)).

Many games provide additional 'Easter eggs', bonuses, and other elements that are not directly connected to the main game goals, though typically there are few if any rewards for learning many of the things in this category beyond the intrinsic satisfaction of having learned them. On the other hand, unless the game is designed specifically as a short form game, not having enough things we CAN learn is a problem, regardless of how much of that we MUST learn. Even if those two elements are well proportioned relative to each other: if they are too small the game will not be engaging.

Verification: What gets included in this category for any given game should be verifiable by the designers. Verification is direct from the source.

Collateral Learning

This set includes all the things people can and do learn that the designers had never really intended. Without the original design documents, it is not possible to distinguish this kind of learning from the first category with any certainty. This set can be extremely large (infinite?) However, we can sometimes pick them out. For example, *Tekken* is a martial arts fighting game. As a direct result of playing this game, players may research and learn about capoeira, which is a Brazilian form started by slaves that combines dance, aerobics and music with mostly kicking. I'm almost certain the designers of Tekken did not plan that.

Collateral learning also includes discoveries within the game that the designers did not foresee. These may be the result of deliberate design elements that combine with each other in unexpected ways - like being able to kill people in the *SIMs* by pushing them into pools that have no water (although, who knows, Will Wright has an odd sense of humour.)

Collateral Learning is most often cited as a detractor by those who do not like the idea of games for education. There is grave concern over what ELSE students may learn and how teachers can CONTROL what students experience. One of the misapprehensions many teachers may have is that learning in traditional settings is somewhat controlled while learning in games or on the web is not. Games present uncertainty, and also a great learning curve, hence, time commitment and most teachers feel a high need for certainty and are time poor. I think another subtext that goes with these concerns is the fear (often

echoed by parents and administrators) that students may learn something dark, evil, or otherwise bad from games. One way to address this is to analyse the game being used.

Verification: Everything that is neither Can nor MUST is collateral learning - which is a much more individual and subjective thing, and therefore impossible to enumerate completely.

Things we DID Learn in the Game

This category is the set of things the player actually DID learn. It may or may not include all those things above, but if one wants to win it must minimally include the set of things one MUST learn to win, though not necessarily in its entirety as explained earlier. If it turns out there is something one MUST learn that is not in the game (i.e. outside the yellow and red boundaries) that means that one must learn it from the game community at large. Many MMOs are like this. Some make it impossible to win things without the help of others.

Verification: What one DID learn is a different story from the rest and we should be able to use the game's assessment mechanisms as well as other known assessment instruments to figure that out.

Cheats

This category is distinct in that these are things that can be learned that essentially alter the rules of requirements of the gameplay. This may include special codes that allow players' characters to gain special powers before they are earned, become invincible, access assets or spaces that would normally be inaccessible, and so on. These would not normally be considered part of normal play, and they are highly unlikely to be an

acceptable part of educational game play unless the objective of the instruction actually deals with cheating in some form. This section is only shown in one image ([Figure 8.2](#)).

Verification: again membership in this set can be affirmed by the designers.

Implications

The absolute sizes of these sets as well as their sizes relative to each other relate to engagement, fun, and learning potential, and it is possible to make some generalizations about successful games based on how these sets are distributed. Most modern, good (= popular, successful, highly rated) games have quite a large set of things you CAN learn, and also ensure that the set is substantially bigger than the set of things you MUST learn. This is an important way to promote exploration.

Figure 8.1 Good Games 1	Figure 8.2 Good Games 2	Figure 8.3 Good Games 3

The Magic Bullet: Learning in Games
Things I CAN learn.
Things I MUST learn to get through the game or meet my goals.
Things I DID learn.
Collateral Learning
© K.Becker 2007

The Magic Bullet
Cheats
Things I CAN learn.
Things I MUST learn to get through the game or meet my goals.
Things I DID learn.
Collateral Learning
© K.Becker 2007

Things I CAN learn.
Things I MUST learn to get through the game or meet my goals.
Emergent behaviours / learning
© K.Becker 2007

| Figure 8.4 Good Games 4 | Figure 8.5 Good Games 5 | Figure 8.6 Good Games 6 |

All three games examined offered many things players could learn that, when taken as a group, meet all six of Bloom's Taxomometric groups (knowledge, comprehension, application, analysis, synthesis, and evaluation) (Bloom, 1964) as well as some psychomotor skills. A representation of the relative balance between required and optional learning is best depicted using the first figure (Figure 8.1) in the 'Magic Bullet'.

Figure 8.7 Pattern Codes
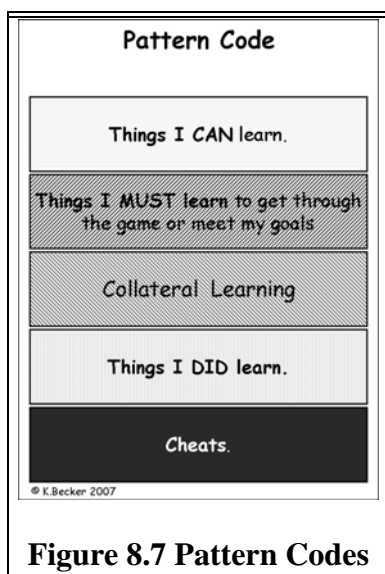
Both *ACWW* and *Black & White* also meet some requirements for affective teaching as well. In all three cases there is much that can be learned, and a substantial, though smaller amount that *must* be learned in order to get to the end or the game. Since *ACWW* does not really have an end-game per se, attaining sub-goals such as paying off the mortgages or completing a collection were treated as wins. Notice that the "Things-I-DID-Learn" (did-learn) category does not completely include the "Things-I-

MUST-Learn" (must-learn) possibilities. This is typical of many top-rated games. For completeness, Figure 8.2 includes a 'Cheats category which is in some sense external to the game and thus shown on the periphery of those things we CAN learn.

Given that this study deals with the design and use of games in educational contexts, the 'Cheats' category should not play a significant role as it is unlikely that they would be deliberately designed[32] into such games and if present, their use would likely be highly discouraged if not downright verboten. However what constitutes cheating in a digital game is open to interpretation (Parker, 2007), so it is something that may require specific delineation when a game is used in an educational context whether that game has been designed specifically for this purpose or not. The remaining four figures of this set depict game designs that can still yield successful games. The third figure (Figure 8.3) shows a design where a high percentage of what could be learned is necessary to get through the game (the oval is large) and what must be learned matches with what actually was learned (they overlap almost completely) and it was all that was learned (i.e. the 'did-learn' oval does not cover any additional 'can-learn' space). In Figure 8.4 there is no collateral learning (this would always be hard to verify). The next image (Figure 8.5) again shows a similar design but this time some collateral learning was included[33]. Finally, Figure 8.6 shows a similar situation where the amount that needed to be learned is quite large, and there is no conceivable collateral learning yet what was learned included no optional items and most but not all 'necessary' ones. All of these designs

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[32] Unless of course the learning objective included plagiarism or some other form of ethics that were related.

could be successful as games, particularly in formal situations, but it should be noted that there was always more that *could* be learned beyond what needed to be learned. At the very least this distribution will allow for further exploration by more motivated learners.
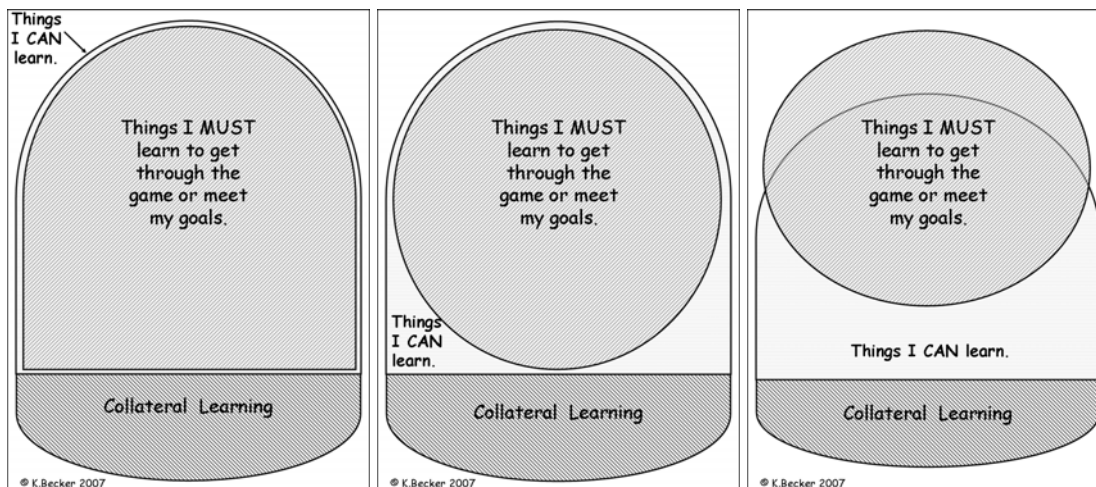
Figure 8.8 Bad Games 1   Figure 8.9 Bad Games 2   Figure 8.10 Bad Games 3
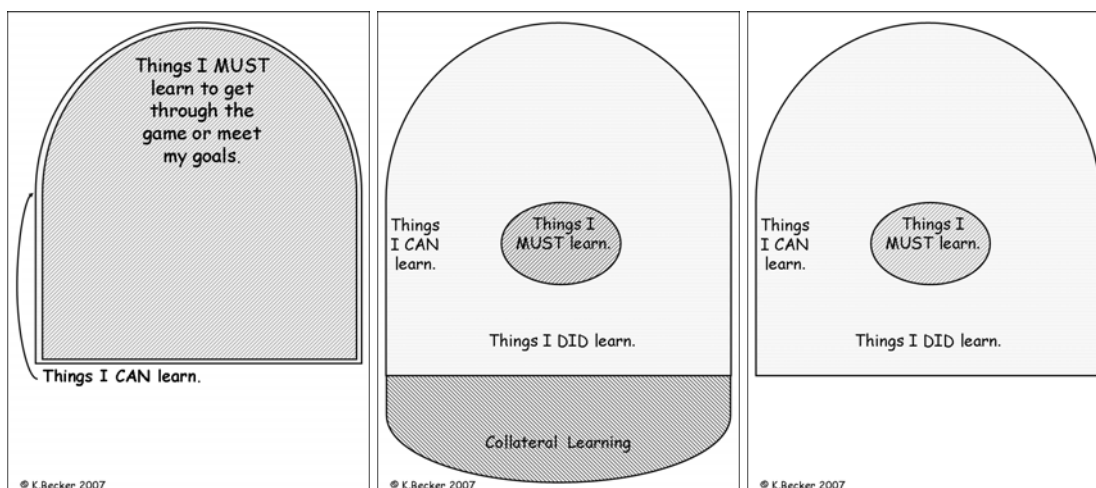
Figure 8.11 Bad Games 4   Figure 8.12 Bad Games 5   Figure 8.13 Bad Games 6

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[33] The prospect of such a situation is one that is often reported as a concern by teachers and school administrators, i.e. there is considerable suspicion about what learners might learn that was not expressly intended be the designers.

Figure 8.14 Bad Games 7
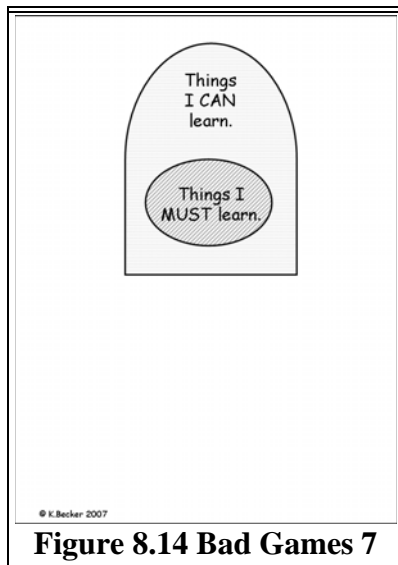
The next set of images depict various configurations of games that would likely not be considered good games. In some cases, these designs can still lead to 'good' (successful, popular, highly rated, effective, etc.) games, but they will require outside support. The first two pictures (Figure 8.8 & 8.9) show games where players are required to learn all or nearly all of what there is to be learned in the game. There are still allowances for collateral learning but there is little or nothing left to learn in the game that is not directly connected to what must be learned. The third image (Figure 8.10) shows a design where some of what must be learned can NOT be learned from the game itself. This would mean that players must turn to the outside community or elsewhere in order to learn what they need to succeed in the game. A design such as this can still be a useful one - in fact most Augmented Reality Games (ARGs) depend on such a design and include requirements for player community support as well as the use of many varied resources from other technologies and the world at large. In the case of ARGs, the must-learn oval could even be largely outside the confines of the Magic Bullet, and still result in a gaining experience that is challenging, satisfying, and doable.

(Figure 8.11) is essentially the same as (Figure 8.8) but without any reasonable expectation for collateral learning. Again, a design like this is not necessarily doomed, but its limitations must be recognized, so while this design may be acceptable for a simple drill-and-practice game, it would not be adequate for much else.

The final three examples show designs where there is relatively little that must be learned. A game where there is little that *must* be learned, there is also little challenge as the challenge in a game often comes from meeting its objectives. In (Figure 8.12 & 8.13) the Magic Bullet is unchanged, except that there is very little that needs to be learned in order to succeed in the game. This design lacks balance, and unless there are challenges and rewards associated with the Can-Learn items, this game is unlikely to be interesting or motivating. In order to recover the balance inherent in most good games, optionally learned items should be logically and thematically connected to the main goals, thus placing them in the Must-Learn category. The balance between Can- and Must-Learn in the final design (Figure 8.14) is reasonable, but the amount to be learned altogether is small, so unless this is a short-form game, it is not a game that players will want to spend much time with.

Outcomes from Formal Observation

The role of the formal analysis was to provide a structured framework within which information gathered about game behaviour could be used to inform instructional game design. The section below is a report of Tinbergen's Four Questions when applied to the studied games at a high level of abstraction. With this analysis it becomes possible to make some general comments about game design for games intended to teach, which follows in the next section.

Tinbergen's Four Questions, Applied Generally

The original purpose of Tinbergen's Four Questions is to frame studies of animal behaviour, and these questions can be applied at both micro and macro levels. Micro

level analyses help to make meaning of individual events whereas the macro level

analyses help to place collections of behaviours into a meaningful context. The same can

also be said when these questions are applied at the micro and macro levels of game

behaviour. Micro analysis helps to inform specific design elements whereas macro

analysis informs guiding principles.

Interaction

[How does it work?] What player or other actions elicit the game behaviour (response),

and how is it modified by changes in input?

It is important to distinguish between player actions and game actions as triggers

of game behaviour especially when examining this question from a macro level (i.e.

whole game or genre). It bears repeating that although what is being identified by this

question is most often a classical stimulus-response sequence, it does not necessarily

mean that the action can only be used in the behaviourist tradition. Given the limitations

of most game interfaces (game controller, touch screen[34]) the kinds of player actions that

can instigate game behaviours is also limited and must be placed in context to be

meaningful.

Game actions don't really 'instigate' behaviour per se, but are frequently indicators

of events that are about to occur or ones that can be selected to occur by the player. All

three games examined use a combination of visual, auditory, and textual cues but they are

not all used each time. *ACWW* does not use the same stimuli or sequence for all

interactions - not even within the same theme. For example fish appear as silhouettes in

the water where the size of the silhouette is roughly proportional to the size of the fish. Players can use this as a clue for the kind of fish they are likely to catch. However, two 'fish' can be identified precisely before they are caught: eels have a unique long and narrow silhouette and frogs are the only fish who make a sound (they croak). Thus although all fish are shown in the water by a silhouette, a few have special qualities. In some cases the sounds are [diegetic](#) (meaning part of the game world) like the frog croaking, and in others they are non-diegetic such as a sudden sound made when a beehive drops from the tree. In this example the sound is intended to represent shock and fear, but does not represent the sound of something hitting the ground.

In all three games, the game responses are highly predictable and change very little, if at all in response to changes in input. This is an important principle to remember when designing educational games: reactions should be predictable within the context of the game. Players should not be left wondering why something happened, or not knowing what to do to make something happen.

Although the user may choose to begin a sequence/behaviour without prompting from the game, once instigated the events are often interruptible. Players are 'locked in' to the sequence and must complete it before they can do something else. This is potentially a very useful device for educational games but it must be carefully designed so as not to trap the player for too long. If this device is being used to facilitate a learning objective or some other learning task, then it is also important to make sure the player has access to assistance and cannot get stuck with no way to help themselves out. The amount and

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[34] The Nintendo DS has a microphone that is used for input in some games, and, of course, the Nintendo

timing of assistance as well as how long is 'too long' will of course vary depending upon the audience.

Ontogeny

[How does it develop (change) during play?] How does the game's behaviour change as players advance (as from level to level), and what changes in the player are needed for the behaviour to be modified?

Many games increase requirements, challenges, and rewards as levels increase but this is by no means an essential requirement, as evidenced by the lack of levels in both *ACWW* and *Black & White*. However, the use of levels has obvious ties to learning outcomes and it can be used to great effect in an educational game. Leveling-up, or getting to the next level always requires the player to meet some challenge or goal. In its most simplistic form, it is like having to pass the unit test before going on to the next lesson. In a game initial levels are often easy and the level of difficulty increases as the levels do. In some cases it may be a matter of quantity: in *ACWW* the mortgage on the players first house is 19,800 Bells, and successive mortgages are: 120,000, 298,000, 598,000, 728,000, 848,000, and 948,000. Each time a mortgage is paid off, they are 'given' the next loan (the player cannot decline) and the player's house gets bigger. Often there is some tangible (in-game) reward associated with finishing a level - new assets become available, new landscape to explore, new characters enter the game, etc. Level design can be demanding and highly complex; so much so in fact that it has become a specialty within the game industry.

Wii is opening up many new possibilities with its controller as well as with it upcoming Wii Fit.

The three games examined support the claim that levels may be a common element in games but they are not essential. The game's behaviour need not develop, but there must still be sufficient challenge and things to do to keep players interested and active.

Function / Purpose

[What is it for?] How does the behaviour of the game help it to 'succeed' in the goal of helping players get through to the end?

Each event must have some purpose though not all rewards must further the goal. In other words, an event could exist 'just for fun' though, clearly in a an educational game this must be balanced carefully against the educational aims (for political reasons if nothing else).

All three games provided ways for the player to personalize their experience. Even *Katamari Damacy* allowed players to make some changes to the Prince's appearance. However, it can not be concluded that this is an essential quality, even though it may be desirable, as games like *The New Super Mario Bros.* have no way for the player to personalize their game, yet it remains a highly popular franchise. Personalization is an example of game behaviour that may not help the player to succeed in the game but merely provides 'fun'. In an educational game some personalization can be useful to distinguish different players, but too many options can lead to learners spending disproportional amounts of time on what amounts to window-dressing.

Evolution

[How did it evolve?] How does the game's behaviour compare with other games in the same genre and how is it related to other genres?

An examination of how a particular game compares with other games of a similar nature or of the same genre is useful to educational game design for several reasons. Almost all British children between the ages of 6-15 have played videogames (Ellis, Heppell, Kirriemuir, Krotoski, and McFarlane, 2006) and over 80% of American children have at least one videogame in their home (Roberts, Foehr & Rideout, 2005), so it would seem reasonable to assume that most children in Canadian schools today have some experience with digital games too, even if they do not play regularly.. This means that they will have acquired a certain degree of 'games literacy' and will have prior learning and expectations about how games work that they bring to any experience with educational games. The runaway popularity of the Nintendo Wii console would seem to indicate that fancy graphics and powerful consoles are not essential but that the interaction is.

Some kinds of behaviours become almost 'standard' for certain kinds of games as well as for games in general. If this were not true there could be no 'literacy'. It is important to understand what those 'standard' elements are so they can be used to effect, and, if the design deviates deliberately there should be a rational justification.

Instructional Game Design

The following is a list of principles that have come out of the current study that are of direct significance to game design for the purposes of learning. These principles are often found in good commercial games, but are not as critical there, and top

commercial games exist which do not make use of these principles. The list is not complete and will be added to as this work continues.

1. When options are presented from which the user must choose, present only those that are relevant. Keep the most common options in the same place in the list. Remember that an options list is not a multiple choice question (misleading alternatives have no place).

2. Always provide the player/learner with easy access to inventory and scores. If there will be a penalty or negative consequence to taking the time to check that information it should be made obvious.

3. All parts of the game must be contextual and have a high degree of conceptual coherence. The possible exception to this rule is the obstacle course style of game (such as *The New Super Mario Bros.* where the obstacles need have no logical connection to the narrative (Becker, 2007g). Consistency of look and feel remains important, regardless of the game's genre.

4. Good interface design is just as important here as it is for any other software application. If poorly done, it can result in sufficient frustration that all hopes of learning are lost. If well done, the player is supported while they play and may not even notice. For example, in *ACWW* one of the special annual events is the 'Acorn Festival'. During this time players can collect acorns and trade the with the mayor for furniture items not available by any other means. Normally when the avatar hands in her acorns she will be told how many more are needed to earn the next prize. On the last day of the acorn festival, when the avatar hands over the last few acorns, she is told how many she has collected in total, but is not told how many she'd need to earn the next prize. Such an omission is not likely to be noticed, but the opposite is not true. It could be quite frustrating if, for example the player was told she needed only two more acorns when there was no way for her to acquire them until the next year.

5. The pacing of the game (i.e. when and how information is provided and challenges are presented) must be matched with the environment in which the game is intended to be used. For example, if the game is intended to be used in a high school social studies class then it must be possible to make significant progress in the game in the space of a single class period.

6. Interactions in good games are efficient. When a question is asked by an NPC players are often given a small number of responses to choose from and only relevant responses are offered.

7. If players may choose their own sequence of activities, make sure that sequence will not interfere with the learning goals. In a game like *ACWW*, players can choose to pursue different goals (see also vertical synthesizers, Reigeluth). If this were a game designed deliberately for education, these may be teacher-lead before or even during gameplay. Different themes could relate to different objectives or aspects of a lesson. However, once a player has chose to pursue a specific goals, there are requirements within the game that must be met before that goal can be achieved.

8. Stuart Walpole shared some principles for creating games for people who have little free time to play (2004) and many of those ideas apply equally to instructional situations. Here too, time 'on task' is at a premium, though for different reasons. Readers are referred to the article for a more detailed explanation, but here is a brief rendition with adaptations for instruction:

    1. Make every moment the learner spends with your application time well spent. [The goal in this 'game' is meeting the learning objectives.]

    2. Spend that time entertaining and rewarding the learner for choosing your product. [Reward is tied to assessment and meeting objectives.]

    3. Challenge without frustrating, and guide while still keeping the learner in control.

4. Your world, your choice. If something isn't fun, don't put it in the application. [This one may be a bit of a stretch and would have to be tied to learning objectives to put it in context.]

5. Keep the learner active as often as possible.

6. But let him leave whenever he wants.

7. And remove any barriers that stop him from picking up where he left off.

8. Keep it simple, keep it accessible, and keep it fun.

9. Don't demand a huge time commitment from the learner or dictate the length of his sessions; let him take it at his own pace.

10. Don't fix things that aren't broken.

11. Test with a wide spectrum of learners and others to find out what's intuitive and well-received.

When looked at from a teaching and learning perspective, Walpole appears to be advocating for efficiency, effectiveness, contextualized environments, and learner control - all 'good' instructional aims. When compared to the principles synthesized from the current study, there is a considerable degree of agreement. Player control, appropriate pacing, ease of access to information, and conceptual coherence were found in all three games studied, and the two games rejected were ultimately disqualified because they failed to implement several of these principles. Building on these principles to an instructional design theory proved to be a challenge, but the lack of a clear model formation was in itself an indication that the problem was what Rittel and Webber referred to as 'Wicked' (1974) as described in the next section.

My Serious Game ID Theory (a.k.a. Instructional Game Design Theory)

People who work with tools need to understand those tools, and we sometimes undervalue the importance of technical acumen when creating artifacts. Some things are just more complex and demand a greater level of awareness than others. Film is more complex than print, as is the web. Games are more complex still. A film director needs to know more than how to talk to actors, and a writer needs to know more than grammar. Clothing designers need to understand fashion, but they also need to understand colour, textures, patterns, the fibers and fabrics they work with, and the bodies that wear their clothes – right down to the muscles and bones. Instructional designers need to understand learning theories and models as well as what goes into designing effective instruction, but they also need to understand their delivery medium – whether it be the web, or film, or print, music, or digital games. The ongoing question is which parts do they really need to understand, and which parts are optional. The outcomes from this research provide at least a few answers. The Serious Game ID Theory (Serious ID) offers a framework in which the principles outlined in the previous section can be applied. Serious ID is a Wicked Problem.

In a previously published work, the author discussed the ways in which Instructional Design could be considered a Wicked Problem and proposed ways to approach the development of instruction with this perspective in mind (Becker, 2007d). There are others who have claimed that many problems in software design are Wicked Problems (Budgen, 2003; Poppendieck, 2004). Given that Instructional Game Design combines aspects of both domains, it is hard to see how it could be anything but a Wicked Problem too. A Wicked Problem, as defined by Rittel & Webber (1974) includes

ten properties which have been briefly defined below in the context of instructional game design:

1. **There is no definitive formulation of a Wicked Problem.** The understanding of the problem progresses as the solution does, and often the problem is not fully understood until the solution is complete.

2. **Wicked Problems have no stopping rule.** Since it is hard to define the problem, it is also hard to declare when it has been solved.

3. **Solutions are not True/False but Good/Bad.** There is no single *right* answer to the problem. Instead solutions are judged on their relative fitness for the purpose.

4. **There is no ultimate test of a solution to a Wicked Problem.** Solutions to Wicked Problems have complex consequences and it is difficult to know how or when all the consequences will have been identified and addressed.

5. **Each solution is a one shot operation.** The consequences to each solution are a result of the solution interacting with the stakeholders and target audience - thus they are unique.

6. **Wicked Problems do not have enumerable (exhaustively describable) solutions.** It is not possible to list all possible solutions and then choose one. There are effectively and infinite number of solutions.

7. **Each problem is unique.** There is no well-defined algorithm (such as a software or instructional design model) for proceeding from the problem to the solution.

8. **Each problem is a symptom of another problem.** These problems are embedded in a social context with various issues that interconnect and interact. Thus changing one aspect often has ramifications to other aspects, creating a new problem.

9. **There are a number of different stakeholders interested in how it is solved.** The roots of a wicked problem can be explained in numerous ways which will vary from stakeholder to stakeholder.

10. **The planner has no right to be wrong.** In other words there is a (perhaps) unreasonable expectation that the designers will produce a suitable, sound and appropriately effective solution in the first attempt.

If we accept that Serious ID is a wicked problem, the next obstacle to tackle is how to approach a solution. The problems are real, and solutions necessary. Knowing that a problem is wicked is of no use if that does not also help us take advantage of tools and techniques suited to addressing these kinds of problems. First, a digital game, when used as an instructional technology *must* be seen as a teaching method rather than a receptacle for content and so the process of creating an instructional game begins with the game design.

The anatomy of a digital game is moderately well understood even if how to design one is not, and a great many successful examples exist to use as guides. There are also considerable resources for the creation of game design documents[35] (Freeman, 1997; Taylor, 2002). A digital game, *even* an educational one must still be a game so it would seem that such a document would be an appropriate place to start when design an educational game. However, as has been made abundantly clear (Crosbie, 2005; Egenfeldt-Nielsen, 2005) simply *inserting* instruction at various points, however strategic they may be does not make a compelling educational game, and has the risk of ruining both - resulting not only in poor instruction, but also a crappy game. No-one wins this

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[35] For more check Gamastra Magazine.

way. With the exception of puzzle style (such as *Tetris* or *Brain Age*) and obstacle course style games (such as *The New Super Mario Bros.* or *Donkey Kong*) the instructional design and the game design must proceed together - the story and premise must justify the learning objectives, and the challenges must further **both** the game challenges and the curriculum.

The design and development of an instructional digital game cannot proceed in a structured, linear fashion (as the traditional software waterfall model), nor as an iterative process (like the Dick, Carey & Carey instructional design model), nor even spirally (such as the de Hoog, de Jong and de Vries model). It is an unpredictable process where progress comes in bursts that sometimes require re-thinking portions that were thought complete. Gustafson & Branch would likely classify an instructional game as having a product orientation and a design model appropriate to this task would include such models as the de Hoog, de Jong and de Vries model or the Bergan and Moore model (2002). Many of these approaches assume that though the initial problem may well be wicked or ill-structured (a lesser form of wicked problem), it can be tamed and that one of the first goals is to produce a clear, precise problem statement, often through extensive front-end analysis.

A variation on a rapid-prototyping model can work in some instances, but effort put into developing a prototype will be wasted unless the problem itself has settled sufficiently to be essentially tame. One of the ore successful approaches to developing solutions to wicked problems is called Scrum (DeGrace & Stahl, 1990). In a Scrum project, input is collected into a list called the 'Backlog' from all stakeholders. Some items will be identified as essential, others desirable, still others are equivalent to wish

list items. This initial discussion can include considerable brainstorming and no ideas are discarded out of hand, even though it is common in more traditional models to discourage 'answers' this early in the design process. Then the development team selects as many of the top priority features from the Backlog as it can develop in a given time period, known as a 'Sprint' (usually one month). After the time is up, the results are presented to the stakeholders, who provide feedback and may reorganize, modify or even add to the Backlog. This means that new questions, tasks, or other elements can be added after each Sprint. The then team selects a new set. Each feature is associated with a time-line or time limit (and information on other required resources). This gives the project leaders a means of tracking progress. The entire Backlog estimates are graphed against the actual cost every three or so rounds. This gives a reliable indication of whether the project is converging towards or diverging from an acceptable solution. It also allows the design and development team to make progress even if the problem is not well understood, and to allow solutions to emerge.

Instructional game design is a highly specialized form of game design rather than a new form of instructional design. It is an instructional method and one that requires and understanding of and expertise in *both* the design and development of digital games as well as the design of effective learning opportunities. An instructional game must include learning that is required in order to succeed in the game as well as learning that can extend the game and provide additional challenge, in balance as depicted in the 'Magic Bullet' and connected through a tight conceptual coherence. Game design documents provide a structure within which one can describe a game design effectively, but cannot ensure the creation a compelling game.

Postlude

The outcomes from the study of the three games examined are neither definitive, nor complete. Not only could much more be learned by studying other games; much more could be learned from continuing to analyse these games. The discussion and resultant outcomes serve here to support the claim that the methodologies developed as part of this work have potential as approaches to the study of games that can inform design. Some of the outcomes and conclusions are likely to become significant in educational game design and others may be refined or replaced or discarded. Game design is far from being a 'science' and so instructional or educational game design still has a long way to go.

CHAPTER 9. THE CALM AND THE STORM: THE NEXT TEN YEARS

(FURTHER WORK)

> There are some things you learn best in calm, and some in storm. *Willa Cather (1915)*

The research reported in this volume has indeed come out of both storms and calm. The original intent when this research was begun was to study commercial game design in order to help inform the design of instructional games with hopes of creating an instructional design theory and model for digital games. In the end, the most significant outcomes of this work will likely not be what was learned about game design, but rather what was learned about how to **study** game design when the goal involves scholarly enlightenment and the advancement of Digital Game Based Learning. This is a very young discipline and it may be that the creation of instructional design models are as yet premature. As Ben Sawyer has said in a recent article outlining ten myths about serious games, "Making a game that teaches a specific lesson is one of the hardest design goals to accomplish (Sawyer, 2007)". Thus it comes as no surprise that the development of an instructional game design model is proving to be an elusive goal.

This chapter is the first of two concluding chapters. Each serves a distinct purpose. This first one summarizes the major findings of the current research that was discussed in Chapters Four through Seven, takes the implications presented in Chapter 8 and outlines some of the work that will need to be done to refine and ultimately accept the methodologies and theories laid out in this volume as reasonable and useful, or reject them as untenable. Although it should come as no surprise that this author hopes the

ultimate outcome is the former, either way we will have learned something, and that in turn advances the field.

The second concluding chapter is the final one in this current work and serves as an afterward of sorts by taking readers back to the vantage point begun in Chapter Two and placing the current research in the larger context of games in education as well as games in society.

Conclusions

> They are ill discoverers that think there is no land, when they can see nothing but sea. *-Sir Francis Bacon*

The original research question that inspired this work was, ***"How does a commercially and critically successful modern video game support the learning that players must accomplish in order to succeed in the game (i.e. get to the end or win)?"*** The conclusions from this work are as follows.

The first step of the investigation was to provide support for the claim that good game design is in accord with good teaching strategies (see Chapter 4). The hypothesis that good commercial games already embody sound pedagogy has been substantiated by the first part of this research with a reminder that a hypothesis such as this can never be formally proven either way. The results from this phase of the research have been published as entirely new work (Becker, 2005d, 2005f, 2006d, 2006e, 2007e & 2008b).

In attempting to fulfill the second part of this work, which was to be able to identify and classify learning objectives in commercial games so they could be used in the design of educational games, it was discovered that major gaps existed in how to identify and select candidates for study as well as how to conduct an analysis once the

games had been selected. This then became the major focus of the second phase of the research. In order to conduct a detailed analysis of several top-rated games a systematic, structured method was needed for ranking commercial games so that the claim that the chosen games were 'good' according to the criteria named could be substantiated. There appeared to be no existing methodology to accomplish this. This prompted a meta-analysis of game study publications to verify this finding as well as the development of a new methodology for ranking games (reported in Becker & Parker, 2008). The new ranking method was used to select three top commercial games for detailed study. These were then analysed using the methodology developed for that purpose, called Instructional Ethology (Becker, 2007i). Instructional Ethology uses techniques and ideas from the study of animal behaviour and adapts them for the study of digital game behaviour.

Often the work of a doctoral dissertation attempts to answer one or two major questions and the final conclusions address those questions directly. In the case of this work, the methodology needed to answer the chosen question did not yet exist, so rather than the major thrust of this work being focused on answering primary research question, it became focused on developing new methodologies. Thus the major outcomes of this research are the explicit connections between games and pedagogy as well as the new methodologies developed for the purposes of selecting and analysing games. It is now possible to use these methodologies to return to the original research question and begin to answer it.

The development of new methodologies must be complemented with evidence that the claims of how they can inform instructional design of games specifically and

game studies generally are more than wishful thinking. All of the new methodologies were used in this research with results that provide a basis for further work. Through a detailed examination of these three highly successful commercial games it was found that a user-centered design where the player has reasonable choices and easy access to feedback are important elements in supporting players as they work their way through a game. Conceptual coherence, defined as the property of a system designed under a unified and coordinated set of design ideas, provides a measure of the relatedness of the concepts in an application and is also an important aspect of successful games. Conceptual coherence of the game's design appears to reduce the player's cognitive load, thus helping the player through the game. The investigation prompted by the original research question has lead to several new methodologies for working with and analysing digital games, explicit connections between commercial game design and instructional design, and new insights to what's important in the design of digital games when viewed from a learning perspective.

If we had it to do over again, what would we do differently? The limitations of a study often speaks to the generalizability of the results. In this case the results of the study portion of the work are likely not the most significant outcomes - the methodologies themselves are, and will require extensive further research to develop fully. Just the same, hindsight is often described as 20-20, and the current research is no different. The development of the Instructional Ethology approach to analysis came fairly late in the process, and while it ultimately became a major outcome of the work, it would have been advantageous to be able to apply this approach to all five games right from the start. Similarly, the late introduction of a well-structured analysis methodology made a

detailed analysis of all but one of the games problematic due to lack of time. In many ways the analysis of the three games examined in the current work could be viewed as a pilot study and further work is essential, as the current model of the methodology is still somewhat vague. Another aspect that would have helped to add weight to the results of the analyses would have been an ability to conduct interviews with one or more of the designers of the studied games to get their perspective. This research has contributed to new knowledge in significant ways, but the work is clearly not finished. The following sections primarily address two questions: 1) What do we know we need to do now, and how does this work help? and 2) What work is needed in order to verify and better focus the outcomes from this work?

What We Know We Need To Do

> That's what learning is, after all; not whether we lose the game, but how we lose and how we've changed because of it and what we take away from it that we never had before, to apply to other games. Losing, in a curious way, is winning. ***Richard Bach***, *The Bridge Across Forever*

At the time of this writing, the most recent major literature review published about games is Sara de Freitas' *Learning in Immersive Worlds: A Review of Game Based Learning* ([2007](#)). This was a meta-review that summarized findings from a wide variety of sources, including other literature reviews and reports as well as discussing results from several new case studies. The list below identifies areas of need.

1. Games need to be embedded into practice and in accordance with sound pedagogic principles and design.

2. More research is needed to

- o provide empirical evidence for how game-based learning can be used most effectively

- o quantify how much and in which ways games and simulations are currently being used most effectively to support learning.

3. More effective supporting materials are needed to support practitioners

4. There is a need for guidelines, case studies and exemplars from current practice to inform and improve the quality of delivery of games-based learning across the sector and to support better future planning and resource allocation.

5. The games development and education communities must be brought closer together in order to build shared vocabularies and expectations

6. New learning designs to support effective game-based learning experiences are needed.

7. Educators and practitioners need to become involved with games development for learning

8. More opportunities for staff development is needed (supported by a more coordinated approach to staff development and opportunities for buying out staff time to allow tutors time to explore and experiment with existing tools and game spaces) (de Freitas, 2007) .

It is difficult to rank the needs identified by de Freitas (2007) as no single need can really be advanced very far without similar advancement in most of the other needs. However, it is clear that no one individual or group can do it all, so the research community and individual researchers must concentrate on those areas where we have the most to contribute. The current research addresses several of these needs. Namely, the present research provides supporting evidence that games can be embedded into practice (need 1) as successful game design is already in accordance with sound principles and

design (as described in Chapter 4). The second area of need calls for empirical research and though there have been several groundbreaking studies (such as Kurt Squire's continued work with *Civilization III*), this is one need that may never be fully satisfied. Some commercial games are beginning to provide more extensive supporting materials (addressing need 3, like *Civilization III*) which will certainly help further 'the cause' of promoting digital game-based learning, and as more games are tried in classrooms, it is hoped that the teachers themselves will contribute. These practitioners will also serve as vital resources in addressing need 4. It has always been a challenge to combine industry and academia, and this is exactly what is needed to help address the fifth need (see also Becker, 2007j). The current research furthers the development of new learning designs (need 6, and Chapter 6) and it is hoped that by making clear connections between established theory in education and established practice in commercial game design, educators and practitioners will be inspired to become better informed and more involved with games development (need 7). Finally, there is always a need for professional development with any new technology (need 8) but advocating time to allow teachers and other faculty to play games is an uphill battle (Becker, 2007j). Though there are undoubtedly areas of need missing from this list, it comes as the result of an extensive examination of other reviews and many other published works. It would appear this list serves as an excellent starting point.

Testing the Methodology

> People expect too much in one year, and not enough in ten.
> *Sir Peter Molyneux*

One of the major contributions of this research to new knowledge is the development of several new methodologies. The data fusion methodology for combining multiple lists described in Chapter Five offers a way to combine disparate lists in a structured and repeatable way that results in a single list. There has been considerable interest in this methodology at conferences where the author has discussed it, from both the research and the industry sectors. Further work could be done to at least partially automate this process as well as to use it in the creation of various lists that focus on specific genres or even different measurable aspects of games, such as community involvement.

The meta-analysis conducted to discover how researchers choose games for study could also be repeated, preferably at regular intervals to assess changes in how choices are made and justified. The meta-analysis in this study found that researchers to not currently appear to choose games for study based on any structured selection criteria. Will this trend continue, or will researchers begin to employ more structured and varied selection criteria?

The second methodology, namely Instructional Ethology provides a means of examining games that focuses on what the *game* does rather than what the player does. Among other things, this can be a means for comparing games with each other and perhaps informing design in such a way as to help us understand why some games succeed while others do not. This methodology can be used to compare games with both qualitative and quantitative analyses, both in the study of games for education as well as on a broader scale. For example:

- Do 'good' games provide more or fewer choices?

- How long are cut scenes?

- What is the connection between console popularity and the success of a game?

- What differences are between short form and extended play games with respect to choices, tutorial help, levels, etc.?

Some immediate possibilities for improvement come to mind, however. The current, two pronged approach is cumbersome and tends to result in a certain amount of duplication. The ontological excavation has already been described as somewhat unwieldy (Hsi, 2005) and this combined with the ethological analysis makes for a considerable investment of time without necessarily an equivalent expectation of return. These two processes need to be compared more closely so that duplication can be eliminated and the entire process can be streamlined into a single approach.

Results from the detailed analysis of the three games indicate that further study of individual games would add further insight. Based on the preliminary results obtained from the current study, a much more detailed analysis of *Black & White* is justified.

Testing the Theory

> You can't steal second base and keep one foot on first. **-**
> *source unknown*

Over time it will become possible to refine the currently vague instructional design model outlined in Chapter 8 and inject more structure or at least guiding principles. However, it is equally important to resist temptations to turn the process into another flowchart-like recipe, for Wicked Problems can not be solved effectively this way. It is also possible that as we gain more expertise and experience in building effective, compelling educational games some patterns may emerge. The application of patterns to

classification and solution of problems has become quite popular, but here again, we must take care to avoid trying to fit a problem to a pattern too soon. Such pigeon-holing may appear to speed the solution process, but it also limits creativity and this is an essential if elusive component in the design of any game.

Growing Questions

> The outcome of any serious research can only be to make two questions grow where only one grew before. -
> *Thorstein Veblen (1857-1947) US Social Scientist*

Research is a never-ending story. This chapter closes with a list of some of the questions that have arisen during the course of this work. As an instructor, this author made it her habit to invite her students to question her teaching with two simple queries: 1) Why am I doing this?, and 2) What is it good for? Thus, the following list includes potential answers to these two questions to compliment the list of research questions, while at the same time highlighting some of the applications of the outcomes of the current research.

How do cultural, social, and economic pressures affect the evolution of games?

This is obviously a complex question that will not have a single sentence answer. The adaptation of an ethological perspective on the study of behaviour in games raises the question of what kinds of evolutionary pressures may exist in game design. It is clear that classical 'survival of the fittest' as seen in nature does not apply. For one thing, games don't reproduce (at least, not yet!). However, the pressures listed in the question do exist and have influence over the kinds of games that are produced. This includes which

aspects of existing game designs are likely to be appropriated for sequels and new games as well as how existing design will be adapted and advanced.

Are there certain learning styles that are better suited to particular types of games?

One body of knowledge that must be developed is to study gamers to determine if particular learner characteristics, learning styles or other characteristic preferences are found to be more common in gamers than would be expected in the general population. If so, then we need to determine whether specific genres of games are preferred by people with specific learner characteristics, learning styles, or all games have similar attractions. This information can be significant in deciding if, and how games can be effectively used in instructional settings.

Do differences in game literacy affect the use of games in schools, and if so, what, if anything must be done to address these differences?

In past generations, the technology available to educators when they were students has not been radically different from what was available to their students. In other words, the world the teachers knew was not so radically different from the world their students know. This similarity of world perspective has often provided an arena for connection between teacher and pupil, but technology has changed so radically in the last generation that the world in which our children are growing up looks quite different from the world their teachers grew up with. There is reason to believe that the majority of teachers and faculty have far less experience with digital games than both their students and the general population. This has implications far beyond those connected with digital games and games literacy, but games are a part of it. Knowing the nature of the

discrepancy in game literacy between learners and their teachers can help identify areas of need in teacher training.

Does game literacy affect technology comfort levels?

Familiarity with games can help build confidence in people not otherwise comfortable with the use of technology. Does increasing someone's familiarity with digital games encourage them to experiment more with other forms of technology? If so, this could be a means to helping technology integration more generally, while at the same time helping teachers create connections with their students.

How do game designers describe the learning players must accomplish in order to get through a game?

There is reason to believe that the best games are in part successful because they already do a reasonably good job of helping players learn what they need in order to get through the game. Though most dame designers are not formally trained in education or instructional design, it would be informative to be able to interview top designers and get their perspective on this. From there it might also be possible to map their insights onto models and theories that instructional designers use to help them in their professions. Ultimately, it may be possible to translate this information into an instructional design theory for games.

Given sufficient time of course it would be possible to continue adding questions to this list almost indefinitely. The work begun here has the potential to grow in various

directions, taking the new contributions further and offering insights to the design of educational games as well as games in general.

In the next and final chapter brings this report to a close by very briefly reiterating how the current research has contributed to new knowledge, and then returning to the original starting point with a final look at the new place of games, both in education and in today's cultural landscape.

CHAPTER 10. DOING WHAT I CANNOT DO IN ORDER TO LEARN HOW TO

DO IT: END GAME

> I am always doing what I cannot do yet, in order to learn
> how to do it. *- Vincent Van Gogh*

The 'endgame' in chess is when there are few pieces left on the board and the players typically adopt a different strategy than they used during the opening and middlegame. This chapter is the 'endgame' of the current research, though hopefully not of the work as a whole. The main thrust of the work described in this dissertation has been focussed on advancing theories in the use of games for learning and in developing methodologies for conducting design and development research in the area. As such the major contributions to knowledge lie not in the results but in the processes developed. These now need to be further developed and refined to ensure that they can be made to live up to their potential.

Epitome

> I have missed more than 9,000 shots in my life. I have lost
> almost 300 games. 26 times I have been trusted to take the
> game-winning shot and missed. I have failed over and over
> and over again. That is why I succeed… *–Michael Jordan*

This research has contributed to new knowledge in several major as well as minor ways. First, it has explicitly connected game design to formally accepted theory and models in teaching and learning. Although others like Gee (2003) and Prensky (2001, 2006) describe general principles, including Gee's 36 principles for learning through games, this work provides new knowledge by explicitly mapping known and accepted learning and instructional design theories and models to the design of commercial digital games. Second, it is the first to conduct a meta-analysis of the criteria used to select

which games to study as reported by researchers. This analysis found that researchers to not currently appear to choose games for study based on any structured selection criteria. Third, a new methodology using data fusion (specifically Borda Counts) was applied to game rankings that can be used to combine any collection of rankings in a manner that is repeatable and verifiable. The fourth contribution is Instructional Ethology, which is a major new methodology for game design deconstruction and analysis. It can be used to extract information about mechanisms that support learning in existing commercial games as well as to provide data for comparisons between commercial and educational games or any other combinations of games. This methodology combines behavioural and structural analysis to examine how games support learning. Further, this methodology can be applied to the analysis of any interactive software system and offers a new approach to studying the user interface. Finally, several new insights into what makes successful games successful can be used to inform educational game design.

The new methodologies and new knowledge constructed in the process of carrying out this research for this dissertation have the potential to serve as the stimulus for further research for many years to come.

Zoom Out: Games and Education

> We need to consider whether we are educating children for
> their futures or our pasts. *Geoff Southworth 2002*

In his studies of engineering education, Richard Felder found that "learning styles of most engineering students and teaching styles of most engineering professors are incompatible in several dimensions. Many or most engineering students are visual, sensing, inductive, and active, and some of the most creative students are global; most

engineering education is auditory, abstract (intuitive), deductive, passive, and sequential. These mismatches lead to poor student performance, professorial frustration, and a loss to society of many potentially excellent engineers (Felder, 1988, p.680)". Just as Felder finds it appropriate to advocate for inductive teaching styles for all types of learners, it may also be appropriate to advocate for supported learner control for all. That learning is more effective, and learners more amenable and responsive when they are given greater control over their learning environment is now a widely endorsed tenet. Games already do this. Control over one's environment is a key aspect of virtually all popular games, from *Lord of the Rings*, to *Paper Mario* and *Metroid Prime*.

Among the things successful games do effectively is teach, whether or not we as a society value what is being taught. In games, for the most part, failure is free, but allowing mistakes takes time and this is runs counter to the goal that many educators espouse, namely to make education more efficient. With budgets being continually eroded, it is hard to argue for anything in education that does not increase efficiency. Learning as defined by the first two levels of understanding in Bloom's taxonomy (Bloom, 1964) which are knowledge and comprehension, has formed the backbone of formal education since the turn of the 20th century. It is no longer sufficient. Learners today need to be able to synthesize and evaluate information and knowledge in the face of a constantly changing technological environment. The virtual worlds of massively multi-player environments and modern digital games provide diverse environments in which this approach to learning can take place, provided educational game designers are up to the challenge of designing and using games and environments that retain those qualities of games that make them compelling, while at the same time offering sound

instructional interventions. One of the ways this can happen is through a balanced synergy between game design and instructional design.

Is there reason to have confidence in Instructional Design as a practice? Many, including this author, believe there is, and there is evidence supporting a basic validity for the claim that deliberate, organized, more or less structured ID promotes the development of sound instruction (Richey, Klein & Nelson, 2004). Structured programming produces better software than what I call "flow-of-consciousness" programming, but one still needs more than an understanding of structured programming to produce good software. In an ACM Forum (Association for Computing Machinery) discussing computer science as a discipline Kurt Guntheroth stated that "CS may be more than programming, but it is not less than programming" (Guntheroth, 2004). A similar statement can be made about the practice of education: Effective education may involve more than sound instructional design, but it is not less than that. The development of effective, compelling instructional games will require knowledge of game design plus knowledge of instructional design, yet it will also require more than that, and although this dissertation has added new knowledge to the question of what else is required, it has not answered it fully, and far more work still needs to be done.

A ground-breaking report released in 2006 by the American Federation of Scientists came out strongly in favour of the use of games as an instructional technology. Among its recommendations were that:

- Educational institutions should develop and execute a strategy for changing instruction to reflect the kinds of learning innovations expected in the coming decade.

- Schools of education should work with the learning games community to develop new and revamp old pedagogy to take advantage of these new educational tools.

- Teachers should be trained to use learning games. ([Federation of American Scientists, 2006](#)).

No-one can truly predict the future, but it would appear that the medium of the videogame is likely to continue to rapidly evolve and grow just as the use of computers and networks has in the last two decades. Together, these technologies are changing how we work, and if they have not yet succeeded in changing how we learn formally, they certainly have already changed how we learn and play informally. Can we really believe that continuing to ban or underutilize digital games in schools, as so many schools have done is going to stem this tide?

Zoom Out: Games and Culture

> Man is least himself when he talks in his own person. Give him a mask, and he will tell you the truth. *-- Oscar Wilde (1854-1900)*

The popularity of digital games as both an entertaining pastime and a new social medium shows no signs of waning. Although perhaps more modest than in previous years, there is continued growth in the digital games industry, and Nintendo's [Wii](#) was the 'must-have' Christmas gift for the second year in a row, and in spite of the fact that the console was released in North America on November 19, 2006 and a production schedule that currently ships 1.8 million Wiis per month, retailers are still unable to keep stock in stores and consumers still line up at the hint of a shipment arriving ([Greenwald, 2007](#)). In Japan, both of Nintendo's game consoles, the Wii and the DS were again top sellers in December of 2007, and WiiFit was the number 3 selling game ([Savino, 2007](#)).

Some consider digital games as nothing less than the next new medium for expression and communication, after film, and television, while others are determined to condemn digital games as the root of all that is evil in today's society. If digital games are viewed as a new idea, technology, or even just as a new computer application (though 35 years of history could hardly classify digital games as 'new'), then we can also look at the migration of game consoles and computer games into people's homes in terms of patterns of technology adoption. If we do that, then with 67% of heads of American households reporting that they play games, and 33% of American households owning at least one videogame console (which doesn't include computer games) (The ESA, 2007) we are already well past the stage of early adopters. In fact, it could be argued that we are in the "heart of the diffusion process" (Jacobsen, 1998) and depending on whether we count reported players or owners of consoles, we could be well on our way to capturing those late adopters. In fact with Nintendo's *Brain Age* becoming the No.7 top selling video game for 2006, and *The New Super Mario Bros.* achieving Number 2, the reign of the casual game may just be beginning.

EndGame

> If you must play, decide on three things at the start: the
> rules of the game, the stakes, and the quitting time. -
> *Chinese proverb*

Finally, we come to the endgame for this dissertation though one hopes not for the work it has begun. Perhaps a fitting way to bring this dissertation to a close is with a brief commentary on comments made by Marshall McLuhan in *Understanding Media* (1964). He devoted an entire chapter to a discussion of games, though he could not have known of the coming videogame revolution - his book was published in 1964 - just about the

time the very first computer games were being written. He wrote his chapter primarily in reference to traditional games and sports, though his description of games as a "kind of model of the universe" (p. 236) could not have been more apt had he written it with hindsight today. McLuhan also described games as "dramatic models of our psychological lives", "dramatic enactments of a cosmic struggle" (p. 237). Interestingly, *Psychonauts*, one of the games on the top games list (see Table A4.6 Final List: Top 100) is exactly that. In this game that takes place in a children's summer camp where the children start loosing their minds. Players must enter the minds (literally) of fellow summer campers to help them recover their minds. Of course, 'dramatic enactments of a cosmic struggle' could easily be used to describe any number of modern digital games, from *Eve Online* to *Metroid Prime* and *Black & White*. "That games are extensions, not of our private but of our social selves, and that they are media of communication, should now be plain. Games are situations contrived to permit simultaneous participation of many people in some significant pattern of their own corporate lives" (p. 245).

If McLuhan is right, and games are a means to re-tribalize a society long accustomed to industrialization and factory-style schooling, then games could easily be an important part of the solution to our profoundly broken[36] education system.

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[36] efficient but not effective

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APPENDIX A - EDUCATIONAL GAME DEVELOPERS

The following is a partial listing of several game development groups and of some recent or well-known educational games, along with brief scenarios. Note that although only the primary designers have been listed, in many cases the development included input from various other people such as students (if the game was designed as part of a course), testers, and other colleagues.

Group: GEL Lab (Games 4 Entertainment and Learning) (Michigan State University)

- **Game(s):** (partial list) Life Preservers, Interactive Drama Architecture (IDA), The Fantastic Food Challenge (FFC), Interactive Storytelling Architecture for Training (ISAT), Mudcraft, Voyage Beijing

- **Member(s):** Brian Magerko, Brian Winn, Brad Greenberg, Carrie Heeter, Mira Lee, Wei Peng, Bill Punch, John Sherry, Ron Tamborini, Ethan Watrall, Rene Weber

- **URL:** http://gel.msu.edu/

- **Brief Description:**

  o Life Preservers is "designed to teach adaptation and evolution at the middle and high school level.

  o Interactive Drama Architecture (IDA) is "a real-time story director agent, which coordinates the game world in response to authored story content, player actions in the world, and an intelligent hypothesis of future player behavior."

  o The Fantastic Food Challenge (FFC) is a collection of games relating to food and nutrition. "FFC is being used in research to test the efficacy of various health care information delivery approaches."

  o Interactive Storytelling Architecture for Training (ISAT) is a dynamically alterable environment for providing individualized training experiences.

  o Mudcraft is a non-violent real-time strategy game.

  o Voyage Beijing is a business travel game that simulates a first business trip to Beijing, China.

- **Comments:** This group conducts extensive playtesting, and has completed a both qualitative and quantitative studies using their games.

- **References:**

Group: The Education Arcade (MIT / University of Wisconsin @ Madison)

- **Game(s):** Environmental Detectives, Labyrinth, Revolution, Supercharged!

- **Member(s):** Alex Chisholm, Eric Klopfer, Scot Osterweil, James Paul Gee, Henry Jenkins III, Kurt Squire, and others

- **URL:** http://www.educationarcade.org/games

- **Brief Description:**

  o Environmental Detectives: An augmented Reality Game played outdoors, "in which players using GPS guided handheld computers try to uncover the source of a toxic spill by interviewing virtual characters and conducting large scale simulated environmental measurements and analyzing data".

  o Labyrinth: A puzzle adventure game for math and literacy learning, targeted at middle-school students.

  o Revolution: A role-playing game based on the Neverwinter Nights game engine, that takes place in in Virginia in 1775 (just before the American Revolution).

  o Supercharged!: A science game that is situated in a 3D space environment where participants navigate a spaceship by controlling the electric charge of the ship and by placing charged particles around space.

- **Comments:** This is one of the more active groups, which not only develops educational games, but also conducts studies using them. Most studies are qualitative case studies.

- **References:** http://www.educationarcade.org/research

Group: Digital Media Lab (University of Calgary)

- **Game(s):** Ocean Quest, Booze Cruise

- **Member(s):** Jim Parker

- **URL:** http://www.ucalgary.ca/~jparker/DML/index.html

- **Brief Description:**

  o Ocean Quest is a 3D interactive game about ocean floor ecology.

- o Booze Cruise is a student built game designed to illustrate impaired driving and its consequences.

- **Comments:**

- **References:**

Group: Serious Games Interactive (IT University Copenhagen)

- **Game(s):** Global Conflict: Palestine

- **Member(s):** Birgitte Holm Sørensen, Carsten Jessen, Simon Egenfeldt-Nielsen, Tasha Buch

- **URL:** http://game.itu.dk/, http://www.globalconflicts.eu//

- **Brief Description:**

- **Comments:**

- **References:**

Group: Environmental Design Virtual Worlds (University of Calgary)

- **Game(s):** Culture in the Language Classroom, Virtual Dieppe, Knight Elimar's Last Joust

- **Member(s):** Richard Levy, Mary Grantham O'Brien, Herbert Wideman, Ronald Owston, Annika Orich

- **URL:** http://www.ucalgary.ca/evds/levy

- **Brief Description:**

  - o Culture in the Language Classroom: A Virtual World Marketplace, 2005.

  - o Virtual Dieppe: intended to help participants understand the importance of topography as a determining factor on the outcome of the Battle of Dieppe.

  - o Knight Elimar's Last Joust: An adventure quest game for promoting literacy across the curriculum

- **Comments:**

- **References:**

SAGE Simulation and Advanced Gaming Environments for Learning

- **Game(s):** Contagion!, Healthsimnet

- **Member(s):** David Kaufman, Suzanne de Castell, Jennifer Jenson, Mike Dobson

- **URL:** http://www.sageforlearning.ca/, http://contagion.edu.yorku.ca/

- **Brief Description:**

    o   Contagion! A game about the spread of virulent disease.

    o   Healthsimnet is a tool for documenting narratives and interactions by health professionals in order to inform game design.

- **Comments:** Projects also include an attempt to build generic game shells into which content can be loaded, and others.

- **References:**

Game: Virtual U

- **Designer(s):** Trevor Chan, William F. Massy, Jesse H. Ausubel, Neil J. Salkind, Ben Sawyer

- **URL:** http://www.virtual-u.org/

- **Brief Description:** A game intended to help people understand the management of an American University or College. Players manage resources such as housing, buildings, and admissions which in turn affect the institution's standings.

- **Comments:** Free. Developed in 2001, it is now in version 2.11, and has been downloaded over 100,000 times.

- **References:** "As of 3/1/05 people who have responded to our installation survey over 25% are using Virtual U as part of a formal training, or classroom exercise at their institution." http://www.virtual-u.org/index.asp

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Game: Virtual Leader

- **Designer(s):** Clark Aldrich

- **URL:** http://www.simulearn.net/leadership_training/leadership_training.html

- **Brief Description:**

- **Comments:** There have been studies done on this game's effectiveness.

- **References:**

APPENDIX B - GAME ELEMENTS

A number of the case studies in Chapter 4 include a visualization of how elements of games connect generally with elements of the ID theory/model in question. The following terminology is included as reference and to clarify how the terms are being used in these visualizations as well as in this chapter. This is by no means a complete list of game elements and only terms that relate directly to the type of examination being conducted in this chapter are explained.

Table A2.1 Game Elements	
GAME ELEMENT	**DESCRIPTION**
A.I. Artificial Intelligence	The core 'engine' of the game that embodies the game's rules and conditions for winning, as well as how the characters within the game will interact with each other.
Attract Mode	This mode is the one that runs when the game is on but not in a state of active play. In arcades, this mode is the one always running when no-one is playing it. Some console games also have an attract mode that runs until the player restarts or continues the game.
Back Story	The story that underlies the game, and sets the stage for the main game goals.
Boss Challenges	These are challenges (often physical conflicts) with a major opponent and often mark the final challenge of a level or the entire game. Many games require players to achieve a certain level of achievement or score in order to earn the opportunity to enter a boss challenge.
Cut Scenes	These are non-playable parts of the game where part of the back-story or game narrative is revealed, typically in small portions lasting anywhere from several seconds to a few minutes. They can be in the same style and quality as the game itself, but they can also appear as movie quality clips.
Game Rules	These are the fundamental mechanics and dynamics of the game and its behavior.
H.U.D. Heads Up Display.	Commonly used to refer to the display board that contains the game's vital information such as score, the player's statistics (health, assets, etc.), current game conditions, and so on. This may also include a map and other information.
L.O.D. / P.O.V. Level of Detail /	Games typically allow players to change the level of detail by zooming in or out. It may also be possible to chage the point of view

Point of View.	so players can see what is behind them or look at objects from a different angle.
Levels	Somewhat similar to chapters in a book, levels are parts of a game that contain one or more complete challenges. Subsequent levels typically build upon previous ones by adding new or more difficult challenges, new abilities, opening up new areas to explore or adding new opponents. Level progression goes from simple to complex or easy to hard.
N.P.C. Non-Playable Character	A character that appears in the game with which you may or may not be able to interact but whose behaviour is determined by the game's design. These characters are not controlled by the player.
Narrative	The ongoing story as it does or can unfold. It is what comes after the back-story, often adding to it.
Outcome	The outcome is the final state of the game. This is a quantifiable (i.e. obvious) state: it will be clear whether or not the player achieved the stated goal. (Salen, K. & Zimmerman, E., 2004, p.96). The win state always depends on the valorization of the game. MMOs and other persistent-world games tend not to have an end outcome, but will almost always have missions, quests, or mini-games that do have clear and definite outcomes. (Juul, J., 2005)
Perspective	First-Person (player as character); Third-Person ("over-the-shoulder"); Top-Down (bird's-eye view); Isometric (tilted top-view; slightly to the side) ; Side-View (two-dimensional horizontal view)
Sandbox Mode	Practice mode, where scores do not count towards a win. Some games contain only a sandbox mode as their primary mode of gameplay, such as the SIMs games.
Story Mode	That part of the game where gameplay is "on-rails", meaning that the player has little to no control over where they go and what tasks they attempt. They are given specific tasks which must be completed, often to a pre-determined minimum level of competence in order to progress. This device is often used to ensure that the player is exposed to specific story elements, and often makes use of cut-scenes.
Time: actual and game-time	The passage of time in games may change between actual real-world time and accelerated, skipped, or even slowed game-time. Often the passage of time during play is reflective of real time, but like in movies, a change of scene or location can also coincide with a change of game time.
Trailers	These are the game advertisements, often containing cinematic quality clips, screenshots of actual gameplay, and other dramatic devices to give potential players an idea of what the game is like.
Tutorial Mode	Often occurring at the beginning of the game but in some games it can also be triggered at the start of a new level or challenge or in response to poor player performance. In this mode the player often receives

	direct guidance, visual, verbal, and otherwise from the game. This mode's purpose is to help the player acquire sufficient knowledge and skill to manage the basic gameplay.
Valorization	Different values are assigned to different outcomes within the game; some are winning outcomes (better) and some are loosing outcomes (worse). Often the more highly valued outcomes are more difficult to achieve than the negatively valued outcomes. (Juul, J., 2005) The values placed on various outcomes as well as the values associated with various choices made during gameplay are determined by the game designers, and may or may not coincide with societal norms, or the value-set personally espoused by the designer.

APPENDIX C PAPERS CONSIDERED FOR GAME CHOICE RATIONALE

STUDY

The following is a list of papers that were examined in detail for the meta-analysis

discussed in Chapter 5. Over 1000 publications were considered, ad those that were

chosen were papers where the study beig reported was based on one or more specific

commercial games.

Table A3.1 Sources Considered	
(published primarily between 2003-2006)	
Source	**Number of Papers Considered**
Games & Culture	35
DiGRA	215
Future Play	62
Author's Personal Reference Library	320
Innovate	100
Google Scholar	~300
total papers considered	~1032

Citations of Publications used in Meta-Analysis

1. Becker, K. (2006, Sept 21-24). **Classifying Learning Objectives in Commercial Video Games: Proof of Concept**. Paper presented at the Canadian Games Studies Association Symposium, York, University, Toronto, Ontario.

2. Bogost, I. (2005). **Frame and Metaphor in Political Games**. Paper presented at the Digital Games Research Association Conference (DiGRA 2005), Vancouver, BC. .

3. Bos, N. (2001). **What do Game Designers Know about Scaffolding? Borrowing SimCity Design Principles for Education** (Technical Report for PLAYSPACE: An examination of learning in multicultural, digital play spaces): Institute for Human and Machine Cognition, The University of West Florida.

4. Brookey, R. A., & Booth, P. (2006). **Restricted Play: Synergy and the Limits of Interactivity in The Lord of the Rings: The Return of the King Video Game**. Games and Culture, 1(3), 214-230.

5. Carbonaro, M., Cutumisu, M., McNaughton, M., Onuczko, C., Roy, T., Schaeffer, J., et al. (2005). **Interactive Story Writing in the Classroom: Using Computer**

Games. Paper presented at the Digital Games Research Association Conference (DiGRA 2005), Vancouver, BC. .

6. Carpenter, R., & White, C. (2005). **Computer Games In The Australian Department Of Defence** Paper presented at the SimTecT 2005 "Simulation – Fulfilling the Promise".

7. Castronova, E. (2006). **On the Research Value of Large Games Natural Experiments in Norrath and Camelot**. Games and Culture, 1(2), 163-186.

8. Chen, M. (2005, June 16-20, 2005). **Addressing Social Dilemmas and Fostering Cooperation through Computer Games**. Paper presented at the DiGRA 2005 2nd International Conference, "Changing Views: Worlds in Play", Vancouver, B.C.

9. Coleman, D. W. (2002). **On foot in SIM CITY: Using SIM COPTER as the basis for an ESL writing assignment**. Simulation and gaming, 33(2), 217-230.

10. Dymek, M., & Lennerfors, T. (2005, June 16-20, 2005). **Among pasta-loving Mafiosos, drug-selling Columbians and noodle-eating Triads – Race, humour and interactive ethics in Grand Theft Auto III**. Paper presented at the DiGRA 2005 2nd International Conference, "Changing Views: Worlds in Play", Vancouver, B.C.

11. Egenfeldt-Nielsen, S. (2003, 4-6 November 2003). **Keep the monkey rolling: eye-hand coordination in Super Monkey Ball**. Paper presented at the Level Up - Digital Games Research Conference 2003, Utrecht, The Netherlands.

12. Fong, G. (2004). **Adapting cots games for military simulation**. Paper presented at the Proceedings of the 2004 ACM SIGGRAPH international conference on Virtual Reality continuum and its applications in industry Singapore

13. Galarneau, L. (2005). **Spontaneous Communities of Learning: A Cross-Cultural Ethnography and Social Network Analysis of Player-Learner Social Networks in Massively Multiplayer Online Games**. Paper presented at the DiGRA '2005 Changing Views: Worlds in Play. from http://www.gamesconference.org/digra2005/viewabstract.php?id=364.

14. Gee, J. P. (2005). **What Would a State of the Art Instructional Video Game Look Like?** Innovate, Journal of Online Education, 1(6).

15. Gouglas, S., Sinclair, S., Ellefson, O., & Sharplin, S. (2006). **Neverwinter Nights in Alberta: Conceptions of Narrativity through Fantasy Role-Playing Games in a Graduate Classroom**. Innovate, Journal of Online Education, 2(3).

16. Grimes, S. M. (2003, 4-6 November 2003). **"You Shoot Like A Girl!": The Female Protagonist in Action-Adventure Video Games**. Paper presented at the Level Up - Digital Games Research Conference 2003, Utrecht, The Netherlands.

17. Gunder, A. (2003, 4-6 November 2003). **As if by Magic: On Harry Potter as a Novel and Computer Game.** Paper presented at the Level Up - Digital Games Research Conference 2003, Utrecht, The Netherlands.

18. Henderson, L. (2005). **Video Games: A Significant Cognitive Artifact of Contemporary Youth Culture**. Paper presented at the Digital Games Research Association Conference (DiGRA 2005), Vancouver, BC. .

19. Houghton, S., Milner, N., West, J., Douglas, G., Lawrence, V., Whiting, K., et al. (2004). **Motor control and sequencing of boys with Attention-Deficit/Hyperactivity Disorder (ADHD) during computer game play**. British Journal of Educational Technology, 35(1), 21-34.

20. Huber, W. (2005, June 16-20, 2005). **Fictive affinities in Final Fantasy XI: complicit and critical play in fantastic nations.** Paper presented at the DiGRA 2005 2nd International Conference, "Changing Views: Worlds in Play", Vancouver, B.C.

21. Jørgensen, K. (2003, 4-6 November 2003). **Problem Solving: The Essence of Player Action in Computer Games**. Paper presented at the Level Up - Digital Games Research Conference 2003, Utrecht, The Netherlands.

22. Kearney, P. R. (2005). **Cognitive Callisthenics: Do FPS computer games enhance the player's cognitive abilities?** Paper presented at the Digital Games Research Association Conference (DiGRA 2005), Vancouver, BC. .

23. Klastrup, L. (2003, 4-6 November 2003). **"You can't help shouting and yelling": fun and social interaction in Super Monkey Ball.** Paper presented at the Level Up - Digital Games Research Conference 2003, Utrecht, The Netherlands.

24. Koivisto, E. M. I. (2003, 4-6 November 2003). **Supporting Communities in Massively Multiplayer Online Role-Playing Games by Game Design.** Paper presented at the Level Up - Digital Games Research Conference 2003, Utrecht, The Netherlands.

25. Krzywinska, T. (2006). **Blood Scythes, Festivals, Quests, and Backstories: World Creation and Rhetorics of Myth in World of Warcraft.** Games and Culture, 1(4), 383-396.

26. Lammes, S. (2003, 4-6 November 2003). **On the border: pleasure of exploration and colonial mastery in Civilization III play the world.** Paper presented at the Level Up - Digital Games Research Conference 2003, Utrecht, The Netherlands.

27. Lankoski, P. (2005, June 16-20, 2005). **Building and Reconstructing Character. A Case Study of Silent Hill 3.** Paper presented at the DiGRA 2005

2nd International Conference, "Changing Views: Worlds in Play", Vancouver, B.C.

28. Lehdonvirta, V. (2005, October 13-15 2005). **Real-Money Trade of Virtual Assets: New Strategies for Virtual World Operators.** Paper presented at the Future Play, The International Conference on the Future of Game Design and Technology, Michigan State University, East Lansing, Michigan.

29. Martin, J. (2005, June 16-20, 2005). **Virtually Visual: The Effects of Visual Technologies on Online Identification.** Paper presented at the DiGRA 2005 2nd International Conference, "Changing Views: Worlds in Play", Vancouver, B.C.

30. Mathews, V., Wang, Y., Kalnin, A., Mosier, K., Dunn, D., & Kronenberger, W. (2006). **Short-term Effects of Violent Video Game Playing: An fMRI Study**. Paper presented at the Radiological Society of North America (RSNA 2006).

31. Morris, S. (2003, 4-6 November 2003). **WADs, Bots and Mods: Multiplayer FPS Games as Co-creative Media.** Paper presented at the Level Up - Digital Games Research Conference 2003, Utrecht, The Netherlands.

32. Mortensen, T. E. (2006). **WoW is the New MUD: Social Gaming from Text to Video.** Games and Culture, 1(4), 397-413.

33. Mosberg, I. S. (2005). **Challenge Balance and Diversity: Playing The Sims and The Sims 2.** Paper presented at the Digital Games Research Association Conference (DiGRA 2005), Vancouver, BC.

34. Myers, D. (2005). **/hide: The aesthetics of group and solo play.** Paper presented at the Digital Games Research Association Conference (DiGRA 2005), Vancouver, BC. .

35. Nitsche, M. (2005, October 13-15 2005). **Focalization in 3D Video Games.** Paper presented at the Future Play, The International Conference on the Future of Game Design and Technology, Michigan State University, East Lansing, Michigan.

36. Oliver, M., & Pelletier, C. (2005, June 16-20, 2005). **The things we learned on Liberty Island: designing games to help people become competent game players.** Paper presented at the DiGRA 2005 2nd International Conference, "Changing Views: Worlds in Play", Vancouver, B.C.

37. Pearce, C. (2006). **Productive Play: Game Culture From the Bottom Up.** Games and Culture, 1(1), 17-24.

38. Purushotma, R. (2005). **Commentary: You're Not Studying, You're Just…** Language Learning & Technology, 9(1), 80-96.

39. Rhody, J. (2005, June 16-20, 2005). **Game Fiction: Playing the Interface in Prince of Persia: The Sands of Time and Asheron's Call.** Paper presented at the DiGRA 2005 2nd International Conference, "Changing Views: Worlds in Play", Vancouver, B.C.

40. Robillard, G. v., Bouchard, S. p., Fournier, T., & Renaud, P. (2003). **Anxiety and Presence during VR Immersion: A Comparative Study of the Reactions of Phobic and Non-phobic Participants in Therapeutic Virtual Environments Derived from Computer Games.** CyberPsychology & Behavior, 6(5), 467.

41. Schrader, P. G., Zheng, D., & Young, M. (2006). **Teachers' Perceptions of Video Games: MMOGs and the Future of Preservice Teacher Education.** Innovate, Journal of Online Education, 2(3).

42. Sicart, M. (2006). **Computer Games, Players, Ethics.** Unpublished PhD, IT University of Copenhagen, Copenhagen.

43. Squire, K. (2003). **Replaying History: Learning World History through playing Civilization III.** Unpublished Doctor of Philosophy, Indiana University.

44. Takatalo, J., Hakkinen, J., Kaistinen, J., Komulainen, J., Sarkela, H., Kaistinen, J., et al. (2006, October 10 - 12 2006). **Adaptation into a Game: Involvement and Presence in Four Different PC- Games.** Paper presented at the Future Play, The International Conference on the Future of Game Design and Technology, The University of Western Ontario, London, Ontario, Canada.

45. Taylor, T. L. (2003, 4-6 November 2003). **Power games just want to have fun?: instrumental play in a MMOG.** Paper presented at the Level Up - Digital Games Research Conference 2003, Utrecht, The Netherlands.

46. Taylor, T. L. (2006). **Does WoW Change Everything?: How a PvP Server, Multinational Player Base, and Surveillance Mod Scene Caused Me Pause.** Games and Culture, 1(4), 318-337.

47. Walshe, D. G., Lewis, E. J., Kim, S. I., O'Sullivan, K., & Wiederhold, B. K. (2003). **Exploring the Use of Computer Games and Virtual Reality in Exposure Therapy for Fear of Driving Following a Motor Vehicle Accident.** CyberPsychology & Behavior, 6(3), 329-334.

48. Warnes, Christopher (2005, June 16-20, 2005). **Baldur's Gate and History: Race and Alignment in Digital Role Playing Games.** Paper presented at the DiGRA 2005 2nd International Conference, "Changing Views: Worlds in Play", Vancouver, B.C.

49. Whang, L. S.-M., & Kim, J. Y. (2005, June 16-20, 2005). **The comparison of online game experiences by players in games of Lineage & EverQuest: Role play vs. Consumption.** Paper presented at the DiGRA 2005 2nd International Conference, "Changing Views: Worlds in Play", Vancouver, B.C.

50. Williams, D., & Skoric, M. (2005). **Internet Fantasy Violence: A Test of Aggression in an Online Game.** Communication Monographs, 72(2), 217-233.

51. Williams, D., Ducheneaut, N., Xiong, L., Zhang, Y., Yee, N., & Nickell, E. (2006). **From Tree House to Barracks: The Social Life of Guilds in World of Warcraft.** Games and Culture, 1(4), 338-361.

52. Young, M., Schrader, P. G., & Zheng, D. (2006). **MMOGs as Learning Environments: An Ecological Journey into Quest Atlantis and The Sims Online.** Innovate, Journal of Online Education, 2(4).

APPENDIX D - CHOOSING GAMES FOR STUDY

The following appendices show samples of the original data as well as the

resultant "Top 100" list, the same list with the excluded games taken out, and the list of

those games to which I have access.

Table A4.1 Abbreviations Legend	
Genres:	Platform:
AA = Action Adventure	Win = windows – PC
RPG = Role Playing Game	PC = personal computer
SP = Sports	PS = Play Station
DR = Driving / Racing	PS3 = Playstation 3
PS2 = Playstation 2	GC/GCN = Game Cube
FI = Fighting	DS = Nintendo Double Screen
FPS = First Person Shooter	GB/GBA = Game Boy (Advance)
ST = Strategy (includes real-time [RTS] and turn-based [TBS])	Wii = Nintendo Wii
SF = Sci-Fi	Xbox
O = puzzle / maze / trivia / parlor / other	Xbox 360
SIM = management / simulation	
Sneaker = shooter requiring stealth and detection avoidance	

Raw Data Samples

Total data records: 1677
Number of Individual games (sequels are counted as separate games): 780

Notes:

All Time Best Lists are ranked, usually by combined review ratings. Mobygames is a somewhat volatile list, so this list was collected several times and only those games appearing on all lists were retained.

Some lists were truncated because the original is too long. All games are scored by calculating a rank as a percent: top of the list = 100% and bottom of the list = 0%. This gives us a value based on the game's relative position in the list regardless of the length of the list. It still gives an advantage to games found on bigger lists, but the maximum

value of each list is now the same, meaning no list can contribute more add more than 1 to any game's accumulated value.

GameCritic.com

http://www.gamecritics.com/review/index.php?esrb=&platform=&category=&date=&critic=&sort=1&order=d Best of all time list collected Nov 11 2006; this list contained hundreds of games. This list also included two review scores, a main one and a secondary one. The top N were chosen, where both scores exist and both are over the threshold of 8.9. The resultant list was sorted descending by main, then 2nd.

Ign.com editor's choice awards[all years]: as of Nov 10 2006

Since there are about 1500 games on this list, I cut it off at anything above a rating of 9.4. That left me with about 211. ign.com

IGDA: Game Developers Choice Awards

"Best Game The Best Game award recognizes the overall best - as interpreted by developers - game released during the year 2006. As these games are chosen from among all games released that year they get a score out of 100

Innovation The Innovation awards recognize games that demonstrate true innovation, advance the state of the art, and push the boundaries of games as an expressive medium. In essence, these are the games that are leading the way as the medium continues to evolve. Up to three Innovation awards may be bestowed on games that contain such outstanding contributions. They are allotted a score out of 50."
http://www.gamechoiceawards.com/

GameCriticsAwards Best of E3 Awards, 2000-2006

BEST OF SHOW gets rated 1 of 10, and best console, handheld, pc get rated 1 of 5 because they all beat others to get chosen.

Ranking mechanism: Best of show = 1/n of categories

Best of console/pc/handheld = 1/n of winners w/ same platform

Others = 1/1 = 1 point

http://www.gamecriticsawards.com/past.html

AIAS – Game of the Year titles

http://www.interactive.org/awards.php

AIAS lists runners up alphabetically so their relative standings can not be assessed. As a result all runners up are assigned the same value. Game of the Year categories count all games listed as winners and runners up that year, and runners up here are all classified as second.

Sports and MMO games cannot be omitted from the lists as they affect the counts allotted to best games.

AIAS innovation category deemed equivalent to the original category of gamecritics

Sample 1: top 10 selling console games for 2001, source: NPD

Table A4.2 Top 10 Selling Console Games for 2001					
Game	**Rank**	**Rank Out of**	**Calculated Score**	**Platform**	**Genre**
Metal Gear Solid 2	1	10	100.0%	PS2	AA / ST
Grand Theft Auto III	2	10	90.0%	PS2	AA
Luigi's Mansion	3	10	80.0%	GCN	O
Halo	4	10	70.0%	XBox	AA
Tony hawk's pro skater 3	5	10	60.0%	PS2	SP
Harry Potter: Sorcerer	6	10	50.0%	PSX	AA
Star Wars: Rogue Squadron 2	7	10	40.0%	GCN	RPG
Harry Potter: Sorcerer	8	10	30.0%	GBC	AA
Madden NFL 2002	9	10	20.0%	PSX	SP
WWF Smackdown: bring it	10	10	10.0%	PS2	SP

Sample 2: Game Spot's All Time Best List (showing the first 12 out of 150)

Table A4.3 Game Spot's All Time Best List								
Game	**Rank**	**Rank Out of**	**Rating**	**Out of**	**Calculated Score**	**Review Date**	**Platform**	**Genre**
Tony Hawk's Pro Skater 3	1	150	10	10.00	100.0%	28/Oct/01	PS2	Skateboarding
Chrono Cross	2	150	10	10.00	99.3%	15/Aug/00	PS	Role-Playing
Soul Calibur	3	150	10	10.00	98.7%	08/Sep/99	DC	3D Fighting
The Legend of Zelda: Ocarina of Time	4	150	10	10.00	98.0%	24/Nov/98	N64	Fantasy AA
Tony Hawk's Pro Skater 2	5	150	9.9	10.00	97.3%	06/Nov/00	DC	Skateboarding
Tony Hawk's	6	150	9.9	10.00	96.7%	2000	PS	Skateboarding

Pro Skater 2								
NFL 2K1	7	150	9.9	10.00	96.0%	07/Sep/00	DC	Football Sim
Perfect Dark	8	150	9.9	10.00	95.3%	22/May/00	N64	FPS
Super Mario Bros. Deluxe	9	150	9.9	10.00	94.7%	30/Apr/99	GBC	2D Platformer
NFL 2K	10	150	9.9	10.00	94.0%	09/Sep/99	DC	Football Sim
Tekken 3	11	150	9.9	10.00	93.3%	1998	PS	3D Fighting
Wario Land 3	12	150	9.8	10.00	92.7%	01/Jun/00	GBC	Action

Sample 3: GameSpy Game of the Year Awards, 2005

Table A4.4 GameSpy Game of the Year Awards, 2005				
Game	Rank	Rank Out of	Calculated Score	Genre
Sid Meier's Civilization IV	1	10	100.0%	ST
Resident Evil 4	2	10	90.0%	FPS
God of War	3	10	80.0%	FI
Mario Kart DS	4	10	70.0%	DR
Call of Duty 2	5	10	60.0%	FPS
Battlefield 2	6	10	50.0%	MMO
Half-Life 2	7	10	40.0%	AA
Dragon Quest VIII: Journey of the Cursed King	8	10	30.0%	RPG
The Legend of Zelda: The Minish Cap	9	10	20.0%	AA / RPG
Tom Clancy's Splinter Cell Chaos Theory	10	10	10.0%	AA / FPS

Sample 4: IGDA Game of the Year Awards

Table A4.5 IGDA Game of the Year Awards			
Game	Rank	Rank Out of	Calculated Score
Shadow of the Colossus	1	100	100.0%
Animal Crossing: Wild World	2	100	99.0%
God of War	2	100	99.0%
Guitar Hero	2	100	99.0%
The Movies	2	100	99.0%

Final List: Top 100

The **accumulated score** is the sum of all calculated scores from all other lists. The **frequency** is the number of times that game has appeared on a list. Notice that the

highest ranking games have appeared most often on the list, but that the co-relationship between rank and frequency is not total, meaning some games that ranked lower appeared on more lists than other games that ranked higher. This happens because the lower-ranked game was also lower ranked in the other lists.

Note also that all time best lists notwithstanding, most lists included games from the last five or so years. If we postulate that approximately 2000 games are released each year, this mean that the games listed below are the top of a list that is effectively 10,000 titles long. The list below represents fewer than 1% of all commercial titles.

ID	Game	Accumulated score	ESRB	Genre	Frequency
	Table A4.6 Final List: Top 100				
1	Half-Life 2	12.70	M	AA	16
2	Halo 2	11.17	M	FPS	13
3	Black & White	11.08	T	RTS	13
4	Grand Theft Auto: Vice City	9.47	R	AA	13
5	Grand Theft Auto: San Andreas	9.02	R	AA	13
6	Legend of Zelda: Ocarina of Time	8.93	E	AA	10
7	Prince of Persia: The Sands of Time	8.78	E	AA	15
8	Tony Hawk's Pro Skater 2	8.69	T	Sport	14
9	Grand Theft Auto III	8.57	R	AA	13
10	Spore	8.50	RP	Sim	9
11	Shadow of the Colossus	8.42	T	AA	11
12	Tony Hawk's Pro Skater 3	8.18	T	Sport	11
13	Metroid Prime	8.03	T	FIGHTING	10
14	GoldenEye 007	7.47	T	FPS	9
15	Deus Ex	7.04	M	AA	12
16	World of Warcraft	7.00	M	MMO	10
17	God of War	6.95	M	ACTION	9
18	Soul Calibur	6.67	T	FIGHTING	7
19	Neverwinter Nights	6.35	T	RPG	8
20	Legend of Zelda: The Wind Waker	6.32	E	AA	9
21	Resident Evil 4	6.25	M	Strategy	8
22	Nintendogs	6.18	E	Sim	7
23	Star Wars: Knights of the Old Republic	6.00	T	RPG	10
24	Halo: Combat Evolved	5.94	M	FPS	7

25	Unreal Tournament	5.50	M	FPS	11
26	Final Fantasy VII	5.32	T	RPG	8
27	Battlefield 1942	5.08	T	FPS	6
28	SSX	5.06	E	Sport	6
29	Half-Life	5.03	M	AA	8
30	Jet Grind Radio	5.02	E	ACTION	8
31	Legend of Zelda: Majora's Mask	5.00	E	AA	7
32	Burnout 3: Takedown	4.91	E	RACING	8
33	Grim Fandango	4.84	T	ADVENTURE	7
34	Animal Crossing	4.82	E	RPG	6
35	Sims 2	4.80	T	Sim	7
36	Guitar Hero	4.66	E	MISC	7
37	Madden NFL 2004	4.57	E	Sport	8
38	Doom 3	4.47	M	FPS	7
39	Shenmue	4.34	T	ACTION	6
40	Elder Scrolls IV: Oblivion, The	4.34	T	RPG	6
41	Metal Gear Solid	4.29	M	FPS	6
42	Call of Duty	4.29	T	FPS	7
43	Madden NFL 2005	4.20	E	Sport	7
44	Gran Turismo 3: A-Spec	4.14	E	RACING	6
45	Chrono Cross	4.13	T	RPG	7
46	Madden NFL 2003	4.10	E	Sport	6
47	Sims	4.00	E	Sim	7
48	Katamari Damacy	3.98	E	MISC	6
49	Soul Calibur 2	3.86	T	FIGHTING	6
50	ICO	3.81	T	AA	9
51	Sid Meier's Civilization IV	3.73	E	Strategy	6
52	Battlefield 2	3.64	T	FPS	6
53	Banjo-Kazooie	3.57	E	PLATFORM	6
54	Perfect Dark	3.31	M	RPG	4
55	Gears of War	3.19	M	FPS	4
56	Diablo II	3.18	M	AA	4
57	Halo	3.15	M	AA	5
58	Samba De Amigo	3.15	E	MISC	5
59	NFL 2K1	3.15	E	Sport	4
60	Metal Gear Solid 2: Sons of Liberty	3.15	M	FPS	5
61	Blade Runner	3.12	T	ADVENTURE	4
62	Tom Clancy's Splinter Cell	3.03	M	FPS (Sneaker)	5

	Pandora				
63	Sims Online	3.00	T	MMO	3
64	Star Wars Galaxies	3.00	T	MMO	3
65	Psychonauts	3.00	T	MISC	3
66	EyeToy: Play	3.00	E	MISC	3
67	BioShock	3.00	RP	AA	3
68	Crazy Taxi	2.98	T	RACING	4
69	Age of Empires II: Age of Kings	2.98	T	Strategy	3
70	Command & Conquer: Generals	2.95	T	RTS	4
71	Jade Empire	2.93	M	MMO	3
72	Sid Meier's Civilization III	2.90	E	Strategy	4
73	StarCraft	2.85	T	Strategy	5
74	Grand Theft Auto Double Pack	2.79	R	AA	4
75	Tony Hawk's Pro Skater	2.75	E	Sport	8
76	Tom Clancy's Splinter Cell	2.74	M	FPS (sneaker)	6
77	No One Lives Forever	2.73	M	FPS	5
78	NFL 2K3	2.65	T	Sport	5
79	Guitar Hero 2	2.62	E	MISC	3
80	Gran Turismo	2.44	E	RACING	4
81	Rayman 2: The Great Escape	2.43	E	PLATFORM	7
82	Tony Hawk's Underground	2.42	E	Sport	5
83	Rome: Total War	2.41	T	AA	4
84	Asheron's Call	2.40	M	MMO	5
85	Metal Gear Solid 3: Subsistence	2.40	M	FPS	3
86	Movies	2.39	T	Sim	4
87	Medal of Honor: Allied Assault	2.37	M	FPS	4
88	Final Fantasy IX	2.35	T	RPG	4
89	Madden NFL 2001	2.33	E	Sport	6
90	Tom Clancy's Splinter Cell Chaos Theory	2.32	M	FPS (Sneaker)	5
91	Unreal Tournament 2004	2.25	M	FPS	6
92	Pikmin	2.25	E	Adventue	3
93	Full Spectrum Warrior	2.25	M	FPS	3
94	Sid Meier's Alpha Centauri	2.20	E	Strategy	3
95	Burnout 3	2.20	E	RACING	3
96	Ratchet & Clank	2.15	T	AA	3
97	Tony Hawk's Pro Skater 4	2.13	E	Sport	4
98	Fallout	2.12	M	RPG	3
99	Super Mario 64	2.11	E	PLATFORM	5

100	Call of Duty 2	2.08	T	FPS	5

Top 100 ("censored")

Note: MMO's, sports games and M-rated games have been removed from list. "Frequency" indicates the number of lists where this game has appeared. Highlighted games are the ones I already own.

Table A4.7 Top 100 ("censored")				
Genre	**Game**	**Score**	**ESRB**	**Frequency**
AA				
	Legend of Zelda: Ocarina of Time	8.93	E	10
	Prince of Persia: The Sands of Time	8.78	E	15
	Shadow of the Colossus	8.42	T	11
	Legend of Zelda: The Wind Waker	6.32	E	9
	Legend of Zelda: Majora's Mask	5.00	E	7
	ICO	3.81	T	9
	Ratchet & Clank	2.15	T	3
ACTION				
	Jet Grind Radio	5.02	E	8
	Shenmue	4.34	T	6
ADVENTURE				
	Grim Fandango	4.84	T	7
	Blade Runner	3.12	T	4
FIGHTING				
	Soul Calibur	6.67	T	7
	Soul Calibur 2	3.86	T	6
FPS				
	Metroid Prime	8.03	T	10
	GoldenEye 007	7.47	T	9
	Battlefield 1942	5.08	T	6
	Call of Duty	4.29	T	7
	Battlefield 2	3.64	T	6
	Medal of Honor: Allied Assault	2.37	T	4
	Call of Duty 2	2.08	T	3
MISC				
	Katamari Damacy	3.98	E	6
	Guitar Hero	4.66	E	7
	Samba De Amigo	3.15	E	5
	Psychonauts	3.00	T	3

	EyeToy: Play	3.00	E	3
	Guitar Hero 2	2.62	E	3
PLATFORM				
	Banjo-Kazooie	3.57	E	6
	Rayman 2: The Great Escape	2.43	E	7
	Super Mario 64	2.11	E	5
RACING				
	Burnout 3: Takedown	4.91	E	8
	Gran Turismo 3: A-Spec	4.14	E	6
	Crazy Taxi	2.98	T	4
	Gran Turismo	2.44	E	4
	Burnout 3	2.20	E	3
RPG				
	Star Wars: Knights of the Old Republic	6.00	T	10
	Final Fantasy VII	5.32	T	8
	Animal Crossing	4.82	E	6
	Neverwinter Nights	6.35	T	8
	Elder Scrolls IV: Oblivion, The	4.34	T	6
	Chrono Cross	4.13	T	7
	Final Fantasy IX	2.35	T	4
RTS				
	Black & White	11.08	T	13
	Command & Conquer: Generals	2.95	T	4
	Pikmin	2.25	E	3
SIM				
	Nintendogs	6.18	E	7
	Sims 2	4.80	T	7
	Sims	4.00	E	7
	Movies	2.39	T	4
STRATEGY				
	Sid Meier's Civilization IV	3.73	E	6
	Age of Empires II: Age of Kings	2.98	T	3
	Sid Meier's Civilization III	2.90	E	4
	StarCraft	2.85	T	5
	Rome: Total War	2.41	T	4
	Sid Meier's Alpha Centauri	2.20	E	3

Games I already own:

Table A4.8 Games I already own				
Genre	**Game**	**Score**	**ESRB**	**count**
AA				
	Shadow of the Colossus	8.41	T	11
	Legend of Zelda: The Wind Waker	6.32	E	9
	ICO	3.81	T	9
ADVENTURE				
	Grim Fandango	4.84	T	7
FIGHTING				
	Soul Calibur II	3.86	T	6
FPS				
	Metroid Prime	8.03	T	10
	GoldenEye 007	7.47	T	9
MISC				
	Katamari Damacy	3.98	E	6
	EyeToy: Play	3.00	E	3
PLATFORM				
	Psychonauts	3.00	T	3
	Super Mario 64	2.11	E	5
RACING				
	Gran Turismo 3: A-Spec	4.14	E	6
	Crazy Taxi	2.98	T	4
RPG				
	Star Wars: Knights of the Old Republic	6.00	T	10
	Final Fantasy VII	5.32	T	8
	Animal Crossing	4.82	E	6
	Neverwinter Nights	6.35	T	8
	Elder Scrolls IV: Oblivion, The	4.34	T	6
	Chrono Cross	4.13	T	7
RTS				
	Black & White	11.08	T	13
	Pikmin	2.25	E	3
SIM				
	Nintendogs	6.18	E	7
	Sims 2	4.80	T	7
	Sims	3.98	E	7
	Movies	2.40	T	4

STRATEGY				
	Sid Meier's Civilization III	2.90	E	4

Data Sources

- Academy of interactive arts and science = AIAS http://www.interactive.org

- GameCriticsAwards: http://www.gamecriticsawards.com/past.html

- International Game Developer's Association = IGDA: http://www.gamechoiceawards.com/

- Metacritic: http://www.metacritic.com

- NPD FunWorld http://www.npdfunworld.com/funServlet?nextpage=index.html rates games by sales

- IGN: http://www.ign.com/

- GameSpot [GP]: http://www.gamespot.com/

- Gamespy [GS]: http://archive.gamespy.com/

Sources of Game Reviews and Other Data

- **NPD FunWorld** The NPD Group (formerly National Purchase Diary) is a leading provider of consumer and retail market research information. This is the primary source of game sales data in Canada and the U.S. http://www.npd.com/corpServlet?nextpage=entertainment-categories_s.html [sample data: http://www.npd.com/press/releases/press_070119.html]

Professional Industry Organizations

- **Academy of Interactive Arts and Science** (AIAS). Holds annual award ceremonies where members make nominations that are then voted upon in much the same way as the Academy of Motion Picture Arts and Sciences. From their site: *Interactive Achievement Award recipients are determined by a vote of qualified Academy members. As such, selection as an Interactive Academy award finalist or recipient represents the strongest possible peer recognition. No person may become a voting member of the Academy unless he or she can demonstrate a threshold level of experience and professional credits in the industry. Interactive Academy voting is secret, conducted on-line, and supervised and certified by our partners at eBallot. The integrity of the system, coupled with a broad-based voting population of Academy members, make the Interactive Achievement Awards the most credible, respected and recognized awards for interactive entertainment software.* http://www.interactive.org

- **International Game Developer's Association** (IGDA): This is the primary professional developer's association, which holds an annual awards ceremony. Any IGDA member in good standing is eligible to nominate a game and vote for finalists. Five finalists are chosen by the advisory board in each category. http://www.gamechoiceawards.com/

Press and Gamer Review Sites

- **Game Critics Awards**: *Game Critics Awards, an independent group of journalists from 36 leading North American media outlets that cover the videogame industry. Each year the Game Critics Awards present its Best of E3 awards.* http://www.gamecriticsawards.com/

- **Metacritic**: *Metacritic® compiles reviews from respected critics and publications for film, video/dvd, books, music, television and games. Our unique Metascores® show the critical consensus at a glance by taking a weighted average of critic grades.* http://www.metacritic.com

- **IGN**: (Independent Game Network) Maintains a Top 100 list, as well as an Editor's Choice list. Both lists focus on recent releases. http://www.ign.com/

- **GameSpot**: A C|NET organization that provides both user and paid reviewer information on games. It maintains a Top Games list that rates games on a 10 point scale. http://www.gamespot.com/

- **Gamespy**: http://archive.gamespy.com/

- **MobyGames**: A Community contributed site that is building a comprehensive list of all computer and videogames. Mobygames maintains Best Of lists which are based on user votes. Scores are listed out of five and include a count of the number of votes that were cast. This list changes in response to user contributions. http://www.mobygames.com

APPENDIX E - GAME BEHAVIOUR DATA COLLECTION

The following are the variables used for the ethological data collection. This list is not meant to be definitive, and like other forms of case study research, there is no single correct approach, nor is there a well-defined set of variables (Stake, 1995). The first set of variables are direct observational records, whereas the second set is the ethological interpretation of that behaviour.

Behaviour Types

In order to distinguish various general types of behaviour it is necessary to develop some terminology that can be used for description. Animal Behaviour studies offer three general terms for this: **event**, **state**, and **bout**. Two others have been added in game ethology to permit somewhat finer distinctions. All five are described below.

- **Step**: This term is new to game ethology and refers to a single, un-interruptable behaviour. very short behaviour or action - usually instigated by one action and either runs till complete, or is exited by the very next action.

  - Example: Watering a single flower in *Animal Crossing*. Once the avatar is properly positioned over a flower, tapping its head, or pushing 'A' causes it to tip the watering can and water pours out. This step can be executed even when the avatar is not properly positioned - the only requirement is that it be holding the watering can and not standing close to another resident (as pushing 'A' when in close proximity to another resident instigates the 'talk' event instead).

- **Event** An event is a behaviour pattern of short duration - in a game this would be one that is not interruptible and must be followed from its inception to its conclusion, even though there may be interactions and the conclusion may vary depending the on choices made along the way. Dialog exchanges in Animal Crossing have this property: the player cannot choose to leave a conversation until it is complete, but there may be several points during the event when the player may choose from among several responses, thus affecting the outcome. Note that a behaviour event may or may not coincide with a logical program event (i.e. one that would be considered an event for a programmer).

- o Example: Watering in *Animal Crossing*. In this case the event includes being in the right place (positioning) with the right equipment, and the actual watering.

- **Bout** This term is also known in Animal Behaviour studies and refers to behaviour patterns that are made up of several events repeated as a group. In game ethology a bout is a series of events which can be terminated at the end of any event, but which logically fit together.

  - o Example: Watering an entire bed of flowers in *Animal Crossing*, or all the flowers in the village can both be considered bouts. A bout can contain other bouts. In some ways a bout is the observable embodiment of an algorithm, and as such can contain other algorithms.

- **Theme** This term is new to game ethology and refers to interruptable behaviours that are related, usually by a game-defined objective. It can include many bouts of activity that can be repeated throughout sessions and throughout the entire game.

  - o Example: Gardening in *Animal Crossing* would be classified as a theme. The objective is a satisfactory environment rating. It includes planting and tending flowers. It can also include moving flowers to create a balance of distributions (which would help meet the objective) as well as simply to make them look prettier (which may or may not help meet the objective).

- **State** This term is also known in Animal Behaviour studies and refers to behaviour patterns of long duration. A state is a relatively stable, potentially longterm condition which may or may not be instigated or terminated by another event. Note that a behavioural state may or may not coincide with a logical program state (i.e. one that would be considered an event for a programmer).

  - o Example: Attract mode in most games is a state, as is a sleeping state (such as at the beginning of *Animal Crossing*.

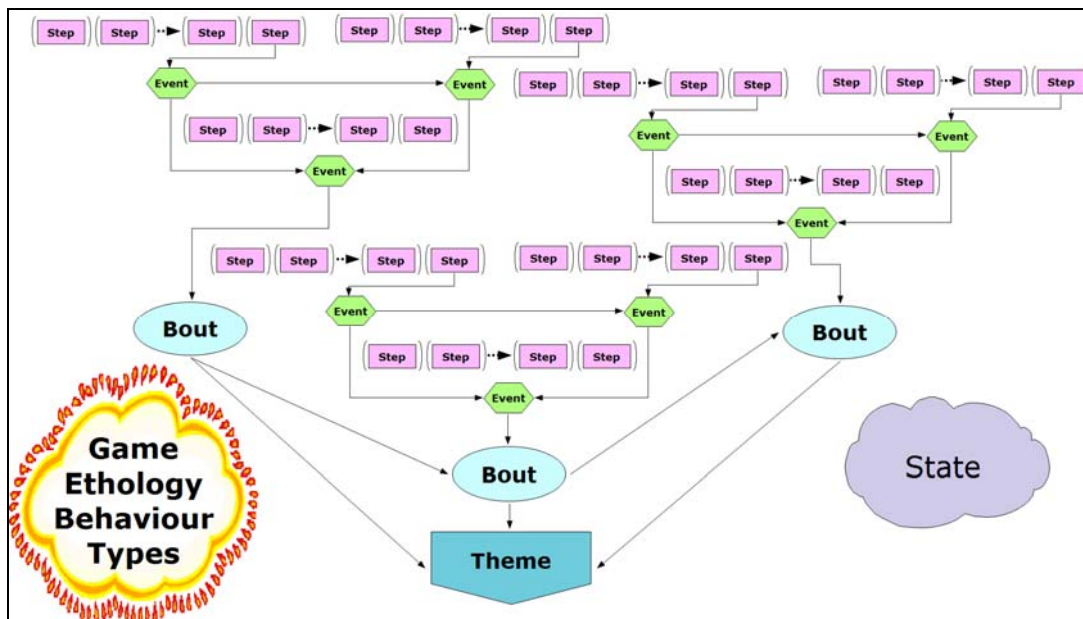| Table A5.1 Behaviour Types				
Type	**Compound**	**Duration**	**Interruptible**	**Sequential**
Step	single act	short	no	n/a
Event	several steps	short-medium	no	ordered
Bout	several events	medium	yes	un-ordered
Theme	events & bouts	level or game	yes	un-ordered
State	no	short-medium	no	n/a

Figure A5.1 Behaviour Type Relationships

Image Source: K.Becker

Observational Variables

The observational variables are relatively neutral in that they are essentially the same regardless of how one intends to focus the interpretation. In other words, whether one is performing an instructional analysis or ethical analysis, these variables can be the same. It is in the second set that the distinctions become crucial. The terms, 'state', 'event', and 'bout' are terms used in describing animal behaviour (Martin & Bateson, 2007) and it is that use of the terms being adapted here rather than software engineering meanings.

- **Game**: What is the name of the game (be specific; include the console if the same game has been released for multiple platforms).

- **Behaviour Type**: What kind of behaviour is being described?
  See above.

- **Duration**: [<10 Sec.; < 1/2 Min.; 1/2-1 Min.; Short(1-2min.); Medium; Long; Indefinite] Duration is a measure of the length of real time an event takes. For the purposes of the analysis conducted in this research, durations were groups into seven categories. Durations are recorded as those that would be experienced under

normal uninterrupted play circumstances (eg. when the player is not interrupted by real-life events). It is recognized that most games will wait indefinitely when waiting for the player to provide input such as an answer or a choice from a list. It should be noted in the data when there is a deviation from this norm.

- **Instigator**: What was the action that started the event?

    o **Random**: This event occurs without any discernible instigator.

    o **Time-Triggered**: The event happens as a result of a specified time having elapsed (such as a timer runs out) or because of a 'calendar' or 'clock' event. Calendar and Clock events can be either in-game or real life.

    o **Player**: The player instigates this event by something she does.

    o **Choose Option**: This event was triggered as the result of the user choosing a specific option. This usually means that this event follows another specific event.

    o **Choose Next**: There are many forms of 'next' in a game: the end of a dialogue sequence may have been reached and the game waits for the player to indicate they are ready to proceed or there may actually be a 'next' option that the player can choose.

    o **State Driven**: A particular condition is met.

    o **Other**: Some other action triggered the event. This is intended to be a catch-all category that should be further explained in the next entry.

- **Entry Event**: This variable is to provide details of the actions that triggered the event.

- **Terminator**: [Random;Time-Triggered;Player;Choose Option;Choose Next;State Driven;Other] These values are the same as the entry actions, but in this case they are to describe the action that caused the event to end.

- **Exit Event**: This entry is for the details of the exit action.

- **Location**: Games exist in a finite space and often behaviours are connected to specific locations. Other times events can occur in various locations. Both can be significant.

- **Scene Description**: Where is the action taking place? The scene should be described; any non-interactive or static objects on the screen should be described.

- **Behavioural Description**: This is a plain-english description of the actions that comprise the event. Any sounds or music; which other characters or objects are in the scene and whether they are active participants in the interaction or not. The actions of the player should be described.

- **Dialogue**: Transcribe any dialogue or other messages that are part of the behaviour.

Interpretive Variables

These variables are described in detail in [Chapter 6](#). What is outlined here are the ways in which the question is coloured by the type of behaviour being analysed. These are the variables whose analysis will determine the flavour of the results. For instructional ethology, these questions all seek to address the main concern of how does this game help players learn?

- **Causation (Interaction)**: How does it work?

  o **Interlude**: How do we get in and out of this interlude, and how does it change?

  o **Event**: What player or other actions elicit the response, and how is it modified by changes in input?

  o **State**: How is this state achieved and what is done to end it?

  o **Bout**: What conditions are necessary to cause these behaviours?

- **Development (Game Flow)**: How does it develop?

  o **Interlude**:

  o **Event**: How does this behaviour change over time, and what changes in the player are needed for the behaviour to be modified?

  o **State**: How does this state change as players advance (as from level to level), and what changes in the player are needed for that change?

  o **Bout**: How do these behaviours change over the life of the game?

- **Evolution**: How did it evolve?

  o **Interlude**: (Same as below.)

  o **Event**: How does this behaviour compare with that of other games in the same genre and how is it related to other genres?

  o **State**: How does this state compare with other games in the same genre and how is it related to other genres?

- o **Bout**: (see above)

- **Function (Purpose)**: What is it for? What are the learning objectives that could be supported?

    - o **Interlude**: Is there an identifiable purpose to this interlude?

    - o **Event**: How does this behaviour help players get to the end?

    - o **State**: What role does this state play in helping players get to the end?

    - o **Bout**: What kinds of instructional goals can be supported through this behaviour?

APPENDIX F - RAW DATA

The following is a sample of the raw data collected during informal observation. There was additional data recorded for each session, including how long the game was played, time start, time end, whether it was an uninterrupted session or if the session had interruptions, where the game was played, and several other details. None of these ended up being helpful, and are not included here.

1 Raw Data: Animal Crossing

CAN Learn		
What I learned	**How I Learned It**	**Bullet Note**
It is possible to find out how much a single item is worth by selling it singly to Tom. He will always pay the same for each item AND it will always be substantially less than it would cost to buy (about 25%).	noting how much I made when selling my fish to Tom.	very helpful, but not necessary
White Scallop = 450; Sand Dollars = 60 bells; Porcaletta = 30 bells; pearl oyster = 1200 bells; red coral = 250 bells; venus comb = 150 bells; conch = 350 bells; dall's top = 90 bells	selling individual or same-type items to Tom	for earning bells
I can change the state of some things - like I can turn lights on and off; x-roids can also be turned on 7 off		
1. I can make a snowball; 2. I can make a snoman; 3. snowballs don't last.; 4. there is a kind of bug (dungbeetle) that ONLY appears with snowballs	1. I accidentally kicked one and it rolled and got bigger.; 2. I rolled a second snowball close to a first one and it combined to make a snowman - he started talking to me.; 3. noticed that snowballs get smaller as time passes; 4. noticed a snowball moving o	
all x-oids bought for the same price.	lamentoids bought for 828 bells; squelchoids bought for 828 bells; mega dimloid's bought for 828	

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Blair saw I had been stung by bees and told me how to avoid it. I have been stung before but i haven't been told before.		
Some things are immediate activities: let's have a fishing contest"; Some things are longer term: like HRA comments & points		
Sometimes; if you are given a sclae of choices (i.e. 10,000 bells → zilch) and you stay in the middle, you get accused of being indecisive and the resident walks away without giving you anything	resident offered me something, asked how much I was willing to pay - I chose the middle - resident got mad and walked away.	
Sometimes; if you refuse to pay for something, they will give it to you anyways.	resident offered me something, asked how much I was willing to pay - I didn't really want it so I said "zilch" - it was given to e anyways.	
special events happen on a semi-regular basis - such as the fishing tournament	I get a notice when I first start up the game - we are shown the town hall and given an announcement - then we go back to where we were	
Some things happen by the clock or calendar.	Observation / residents tell me.	
some fish can be identified by their silhouette before they are caught - eels, frogs (croak) - different sizes of silhouettes represent different sets of fish		
When flowers turn brown, watering them one time will fix them	A resident told me.	
1. sick friends need medicine; 2. can't give medicine to a sick friend > 1 time per day; 3. medicine fixes bee stings. Just drag it from your pocket to yourself.	1. I noticed that I hadn't seen one of the residents for a while - went to her house and she was making 'sick' sounds. When I talked to her she said she felt awful - when I got a chance to respond one of the options was "Need medicine?"; 2. I tried it; 3. I	
I don't need to water flowers when it is raining.	A resident told me.	
some residents are permanent;	observation, repetition, acclimatization	

some appear by the clock & calendar; some live in houses - all the ones that live in houses will come and go - none of the others leave permanently.		
houses appear & disappear with the residents that live in them so don't plant where a house could go	observation, repitition, acclimatization - I planted a lovely tree; it didn't grow; I planted some nice flowers, the house went on top of them; in my own hose I lost several fruit trees when my house got expanded.	
covering my eye with something (mask or eye patch) doesn't stop residents from recognizing the I've been stung by bees.	experience	
residents are more likely to try and sell you things when you have money and they are more likely to give you things if you have no money -if you want to make money and keep residents happy, go to the bank and make deposits often.	observation / experience	
when I am "nice" to residents I am more likely to get rewards.	observations; experimentation	relationships
there are patterns to conversations - certain answers always ellicit the same responses - they are not random.	experience, experimentation, observation	relationships
each tool has a golden equivalent	game guide	
The HRA rating values	move a single item and wait for the next report.	

General Observation		
What I learned	**How I Learned It**	**Bullet Note**
There are times when the game does not supply sufficient information (One possible explanation is that we are supposed to ask the player community) e.g. I STILL don't know what to do with the bags of bells I find		
1. different characters and places are for different purposes	game literacy: commonly used device in games. Here certain residents are rarely seen outside	

	their 'normal' locations.	
I have no choice over bigger houses	- as soon as I pay off a mortgage, the next day Tom gives me a new addition - even if I say NO	
There is ALWAYS something I can do to advance towards my goal even though not all have the same value.		
players of games look for patterns - this makes the game more predictable and allows the player to focus more on those aspects that interest him/her eg. There are 3-4 beehives in the trees each day; also about 3 new weeds; 1 money rock; 2 furniture items	observation, experience	
Each subgoal has a distinct reward: collect one of each fish, get the golden fishing rod; keep the environment perfect for long enough, get the golden watering can, collect one of each bug (much harder than fish), get the golden net, maintain a good relationship	told by residents, game guide (note that details differ between game guides: such as how many days you need to keep the environment perfect to get the golden can), experience	

MUST Learn		
What I learned	**How I Learned It**	**Bullet Note**
"waking up" is a process; time in the game is connected to the console's clock	noticed that game time was 'real time' - when I played again later - time had elapsed.	
not to close the game without saving	the next time I started the game, I was visited by a mole who gave me a long and 'angry' lecture. He also explains how to save.	
certain kinds of items can be used only in certain contexts.	when presented with a choice (selling, donating items, etc.) only permissible (although not necessarily wise) choices are highlighted	
there are major and minor goals; Some things matter more than others: e.g.. Interactions with friends matter - don't screw them up - interactions with merchants matter less	learning by dong: consequences for actions; time on task	
interactions: from time to time I get visitors to my house - I have to be nice: if I am I get presents; if I'm not I get nothing and they might move away.	learning by dong: consequences for actions; time on task	

When fishing: fish don't come back if you pull your lure out of the water once they have started to bite at it.	observation	
There are special days where certain things can happen: e.g. flea market day - I must learn how to price things if I wish to sell them: –> If too high: "What?!" asks to cut deal; if "No Deal" walks away and I lose my chance to sell the item. ===⟹ If I do	experience	making money / relationships
Some things I do don't show effect till the next day (like watering plants to keep them from dying).	experience -	
1. if I don't respond quickly when someone wants to talk to me, they won't wait.; 2. Sometimes when residents want to talk to me they will give me presents (sometimes they will try to sell me things).; 3. Sometimes they ask me questions: right answer = happ	observation. The game is quite consistent and gives me lots of opportunities.	if you are interested in relationships.
Common weeds look like grasses - they are green.; Weeds need to be pulled or they will get bigger and more numerous.	observation	
There are many choices: some things need to be learned to meet goals e.g. sea fish are typically worth more than river fish.	noting how much I made when selling my fish to Tom.; Must keep track of details	
There is a random element to whether or not a fish can be caught (assuming your own timing for reeling it in is OK)	observation –> conclusion	
the environment needs daily tending	After several days' absence there are changes: weeds; dead trees;	if you are interested in the environment
some game assets are replenished / changed each day (Tom's store); bell rock; others change only semi-regularly: lost & found; recycle bin ===some spots are worth checking	observation	

daily, others not		
If I talk to residents they tell me things that are useful, like: "I planted my trees in shade made by my home and they all died.", or that is is good to collect the same series furniture	the people in the game give me hints but they may not be direct: Nan: "I completed the series of furniture I was collecting and got lots and lots of points.	
only some places are good for growing trees	sometimes when I plant a tree is just dies	if interested in environment
the residents help me		
available options help me know when I am on the right track.	Apollo asked for a rare fish, after I had caught one, I went back to Apollo and he paid me for it. There is no "Give this option" till I have the fish and go see the right resident. ; Goose said he loved shirts. When I bring Goose a shirt, there is a new o	
Residents will buy things from me and give me challenges.	Apollo asked for a rare fish, after I had caught one, I went back to Apollo and he paid me for it. There is no "Give this option" till I have the fish and go see the right resident. ; Goose said he loved shirts. When I bring Goose a shirt, there is a new o	
the Axe becomes worn and eventually will break.	The image of the axe changes gradually, and then one time it breaks.	If you want to cut and plant trees
what to do with bags of bells	Up till now I've been playing w/o knowing - I buried a bunch; I even put some in recycling, then (thanks to Bailey) I discover that all I have to do is drag the bag from my inventory to my purse.	to earn money
mortgages go up in price fast:; #1 = 19,800; 2 = 120,000; 3 = 298,000; 4 = 598,000; 5 = 728,000; 6 = 848,000; 7 = 948,000		to pay off mortgages
Learn about the Landscape; - trees, flowers; ocean, river, ponds, waterfalls; rocks; stone areas in front of buildings;	time on task - wandering about	orientation

signs mark locations of houses	noticed the signs - they have things (hints, sayings) on them. Noticed that when a new house arrived, the sign I had read before was now the house marker.	
places have specific purposes or roles within the game	residents told me about specific places and people; I noticed that some (like Blathers) are always in the same place and never move. Tom is the only exception and that is only at the beginning of the game.	
things that can be collected for reward: fossils; fish; bugs; furniture; household items (for feng shui) things that can be collected for little reward: clothes; constellations; tunes; paper	observation, repetition, acclimatization, told by residents	certainly to do collecting
basic game interaction / interface:; How to talk/sell stuff/buy stuff	Tom meets me at my house, hires me and tells me to go to his store.; When I get there I am given a uniform to wear (teaches me how to change my appearance); then he gives me seven tasks: plant trees & flowers; introductions; deliver furniture; mail letter;	
Pelly / Phyllis will tell me about the environment	One of their options is "Environment" and when you choose that they will tell you - she will say what is needed ("Could use more green.")	If interested in environment
About relationships: the introductory remarks of a new resident will give some indication of its personality type (there are maybe 6 distinct ones).; The personality type determines which answers will be appropriate to certain uestions (like, "Did I take a	after a while one notices that new residents say the same kinds of things as previous ones did.	for relationships
how to identify dead flowers: they are the same shape, but all brown. This is useful for keeping a healthy flower population - you can't keep enough flowers through just planting, and it helps to know	told by residents ALSO: I noticed that it happened to a flower I knew I had planted. At first I thought these brown things were more weeds and I just pulled them. They disintegrate when pulled.	for environment

which flowers to water.		
a resident's picture is the reward for a good relationship.		

Theory Building		
What I learned	**How I Learned It**	**Bullet Note**
There are many choices: some things need to be learned to meet goals e.g. sea fish are typically worth more than river fish.	noting how much I made when selling my fish to Tom.	

2 Raw Data: Katamari Damacy

CAN Learn		
What I learned	**How I Learned It**	**Bullet Note**
My ability seems to improve after some time away	I had been struggling with one level and when I can back to it I was much better.	
that things fall off the katamari if i bump into stuff	experience, observation	

General Observation		
What I learned	**How I Learned It**	**Bullet Note**
part of the game is uncovering the rules - they are rarely given all at once, and they are rarely all in the documentation.	looking for them - I discovered rules on my own	rules
I should expect to have to repeat a level many times before I complete it. The repitition helps me become familiar with the terrain and helps me plan a strategy for success.	Each time through I learn something else *not* to do, to do, to watch for or to look out for.	time on task & repetition

MUST Learn		
What I learned	**How I Learned It**	**Bullet Note**
I can't play until I have passed the tutorial sections	verbal explanations are always accompanied by visual demonstrations; information is presented in smallish chunks	
name of King: King of all Cosmos; He has messed up all the stars and we (his son) have to fix it by rebuilding them out of Katamari.	the King told me	intro
how to control the vibration in the game controller - use the select button	the King told me	basic controls
The basic controls for rolling the katamari	tutorial mode: there is a visual representation of each of the main	basic controls

	moves (forward, back, turn, etc.); we are shown 8 different moves and each time we do one of them, the 'icon' changes colour, vibrates and makes a sound. Once we have completed tham all,	
there are things that can sneak up on me, but I will get a warning on the screen when that happens	the king told me early in the game	gameplay
I should try not to bump into things that are bigger than me - especially live things it won't end the game though	the king told me early in the game	
1. I can't roll up objects bigger than me; 2. the katamari can roll up odd shaped things but then it will roll lopsided; 3. I can roll up animals but not people and cars - only after I hit them - till I get bigger; 4. I can push up steps - the size I can cli	told after intro level	rules
after each level I a told how big I am (as big as 256,000 pop cans), how many items I collected and the three most coon types of things (stationary, candies,…)	status screen after each level.	keeping score
once I complete a kamari, it gets released into the sky as a star. I can also make constellations. I can always go back to try again and to increase the size of my katamari. When done I can choose to keep it and replace the previous one, or, in the case of	observation, experience	keeping score
as I get bigger I am more likely to get stuck in places.	experience, observation	strategy
There are strategies to be learned - without them you can't get through the levels after the first few.	Repetition (drill?) After going through a course many times I begin to get a picture of the space and where the better 'stashes' of stuff are.	strategy
Some items are worth more than others, and some are dangerous (cause me to get thrown around)	observation - the counter measures the size of the katamari	strategy
some items must be avoided while the katamari is small. If I hit them I can	observation - the counter measures the size of the katamari	strategy

get thrown about and loose bits.		
If an animal is unafraid, I cannot roll it. Once it becomes afraid of my katamari and tries to escape, I can roll it.	experience	strategy

Theory Building		
What I learned	**How I Learned It**	**Bullet Note**
the back story doesn't need to be first	here we get a brief intro to the two main characters, then we go through orientation, THEN we get the backstory. The king of all cosos broke the sky, and now the prince must return the stars.	

3 Raw Data: Black & White

MUST Learn		
What I learned	**How I Learned It**	**Bullet Note**
My 'presence' in the game is a Hand. (White told me)	NPC's talk to you - primarily White and Red - tells you how to operate things; sometimes they show you how. Moving around: White tells and shows me, then asks me to try it.	
narrator calls it God's playground; there are story scrolls		story scrolls provide vital info

Other		
What I learned	**How I Learned It**	**Bullet Note**
TURNS OUT: this is how you choose a symbol –> not yet clear what it is good for.		

APPENDIX G: LINKS REFERENCED IN TEXT

This document has been produced in both online and print form. The online version contains numerous live links to other resources, which have been expanded here for the print version. Most entries are sorted alphabetically by highlighted phrase. Names of people are sorted by last name. The numbers in square brackets indicate the chapter(s) where this link appears.

Abel, Niels H. http://www.abelprisen.no/en/abel/ [4]
Academy of Interactive Arts and Sciences http://www.interactive.org/ [5]
AllGame http://www.allgame.com/ [5]
Amos and Andy http://www.amosandy.com/ [4]
Babbage, Charles http://www.charlesbabbage.net/ [6]
Bach, Richard http://www.inner-growth.info/private/richard_bach_biography.htm [9]
Bacon, Sir Francis http://www.luminarium.org/sevenlit/bacon/ [9]
Birth of a Nation (film) http://imdb.com/title/tt0004972/ [4]
Blake, William http://www.blakearchive.org/blake/ [5]
Bonobo http://bonobo.org/ [2]
Cather, Willa http://www.willacather.org/ [9]
Cervantes, Miguel De http://quixote.mse.jhu.edu/Cervantes.html [4]
Chaplin, Charlie http://www.charliechaplin.com/ [4]
Christmas Carol (novel) http://www.literature.org/authors/dickens-charles/christmas-carol/ [4]
Contagion Game http://contagion.edu.yorku.ca/ [3]
Croft, Laura http://www.tombraider.com/ [4]
Dead Like Me (TV show) http://www.deadlikeme.tv/ [6]
Dewey, John http://www.iep.utm.edu/d/dewey.htm [4]
Dickens, Charles http://www.victorianweb.org/authors/dickens/dickensov.html [4]
Difference Engine http://en.wikipedia.org/wiki/Difference_engine [6]
Digiplay Initiative http://digiplay.info/ [3]
Digital Media Lab http://www.ucalgary.ca/~jparker/DML/index.html [3]
DiGRA (Digital Games Research Association) http://www.digra.org/ [1, 3]
Don Quixote (novel) http://www.donquixote.com/english.html [4]
Donald, Merlin http://psyc.queensu.ca/faculty/donald/donald.html [2]
DS Handheld Console http://www.nintendo.com/channel/ds [3]
Ducks in the Classroom http://www.minkhollow.ca/HatchingProgram/index.html [1]
Education Arcade http://www.educationarcade.org/ [3]
Educational Technology Magazine http://www.asianvu.com/bookstoread/etp/ [3]
Eibl-Eibesfeldt, Irenäus
http://evolution.anthro.univie.ac.at/institutes/urbanethology/staff/eibl-eibesfeldt.html [2]

Engeström, Yrjö http://communication.ucsd.edu/people/f_engestrom.html [3]
Entertainment Software Association http://www.theesa.com/ [5]
Escher's World http://epistemicgames.org/ew/start.html [3]
Facebook http://www.facebook.co/ [2]
Fairbanks, Douglas http://douglasfairbanks.org/ [4]
Feynmann, Richard http://www.feynman.com/ [3]
Franklin, Ben http://sln.fi.edu/franklin/rotten.html [2]
Friedman, Thomas
http://topics.nytimes.com/top/opinion/editorialsandoped/oped/columnists/thomaslfriedman/index.html?8qa [3]
FutureLab http://www.futurelab.org.uk/ [3]
Gagne's Nine Events of Instruction http://www.e-learningguru.com/articles/art3_3.htm
Gamasutra Magazine http://www.gamasutra.com/ [8]
Game Spot http://www.gamespot.com/ [5]
Game Stats http://www.gamestats.com/ [5]
GameCritics http://www.gamecritics.com/ [5]
Gamecube http://www.nintendo.com/systemsgcn [3]
Games for Entertainment and Learning http://gel.msu.edu/ [3]
Gamesnetwork (mailing list) https://listserv.uta.fi/cgi-bin/wa?A0=GAMESNETWORK [3]
Gide, Andre (1869-1951) French Novelist http://www.andregide.org/ [1]
GO http://www.intgofed.org/ [7]
Goodall, Jane http://www.janegoodall.org/chimp_central/default.asp [2]
Gutenberg http://inventors.about.com/od/gstartinventors/a/Gutenberg.htm [2]
Handy, Charles http://en.wikipedia.org/wiki/Charles_Handy [1]
Harris, William (U.S. Commissioner of Education)
http://www.johntaylorgatto.com/chapters/5k.htm [1]
Hatching Project Candling Tutorial
http://www.minkhollow.ca/HatchingProgram/Candling/index.html [1]
Helwig's Game http://www.lyonstudio.com/history-history-of-wargaming.html [3]
IEEE Game Bibliography http://www.ucalgary.ca/~jparker/TFGT/publications.html [3]
Independent Game Network http://www.ign.com/ [5]
International Game Developers Association Game Choice Awards
http://www.gamechoiceawards.com/ [5]
Indiana University http://www.indiana.edu/   [1]
IT University of Copenhagen http://www1.itu.dk/sw5211.asp [1]
Jenkins, Henry III http://web.mit.edu/cms/People/henry3/ [4]
Jordan, Michael http://www.nba.com/playerfile/michael_jordan/ [10]
Jung, Carl Gustav http://www.cgjungpage.org/ [7]
Kipling, Rudyard http://www.kipling.org.uk/ [7]
Kirriemuir, John http://www.silversprite.com/ [1]
Köhler, Wolfgang http://www.kirjasto.sci.fi/kohler.htm [2]
Lee, Harper http://en.wikipedia.org/wiki/Harper_Lee [4]
Levy, Richard http://www.ucalgary.ca/ev/people/faculty/profiles/levy/index.htm [3]
Link from Zelda http://www.zelda.com/universe/ [4]

University of Wisconsin-Madison http://cimc.education.wisc.edu [1]
Valentino, Rudolph http://www.imdb.com/name/nm0884388/ [4]
Van Gogh, Vincent http://www.vangoghgallery.com/ [10]
Veblen, Thorstein http://www.econlib.org/library/Enc/bios/Veblen.html [9]
Vygotsky http://www.kolar.org/vygotsky/ [3]
West Wing http://www.nbc.com/The_West_Wing/ [4]
Wii (console) http://wii.nintendo.com/ [4]
Wii Fit http://www.wiifit.ca/ [8]
Wilde, Oscar http://www.cmgww.com/historic/wilde/ [10]
Wright, Will http://en.wikipedia.org/wiki/Will_Wright_(game_designer) [2]
Xbox http://www.xbox.com/en-US/XBox [3]
YouTube http://www.youtube.com/ [2]