Project TECHNOLOGIA: A Game-Based Approach to Understanding Situated Intentionality

Stephen Thomas Slota

University of Connecticut - Storrs, stephen.slota@uconn.edu

Follow this and additional works at: https://opencommons.uconn.edu/dissertations

Recommended Citation
https://opencommons.uconn.edu/dissertations/638
Abstract

Since the early 2000s, educators, administrators, politicians, and researchers have given increased attention to the potential affordances of video games for educating K-12 and university learners. This has led to the instantiation of numerous game-based learning and instruction journals, investigations of efficacy, achievement, and motivation using multimillion dollar tools, and a federally-funded competition for science, technology, engineering, and mathematics game development. Yet, little is known about the way particular game mechanics, narrative structures, and community-driven tools (e.g., forums, cheat guides, mods) influence the skills needed to be a successful 21st century learner. Few studies have catalogued the particular actions and thoughts of particular players playing particular games, and even fewer have addressed the possible affordances of narrative, co-constructed storytelling, and student agency in educational game environments. In response, this dissertation discusses how increased emphasis on intentionality, game design, and narrative may expand on not just what is known about games and gameplay but also how educators can leverage game mechanics, embedded social collaboration, and stories toward the fulfillment of complex objectives like transfer and curricular goal adoption. Qualitative data collected from a text-based, dual alternate reality-roleplaying game was used to conduct grounded theory analysis of emergent player-player, player-instructor, and player-game interactions across a five-month period. Findings suggest that game-based learning and instruction may be optimally studied as dynamic, in-the-moment agent-environment interactions rather than single-purpose independent variables. Additionally, participant outcomes support the application
of a Technology, Pedagogy, Content Knowledge, and Learning Theory (TPACK-L) design framework and, by extension, contemporary learning theory as part of game development. While there is still much to be learned, this work represents a step forward in the development of more robust, situated theories of game-based education and may help resolve recurring questions about games, play, and the nature of human thinking and learning.
Project TECHNOLOGIA:
A Game-Based Approach to Understanding Situated Intentionality

Stephen Thomas Slota

B.S., University of Connecticut, Storrs, CT, 2007
M.A, University of Connecticut, Storrs, CT, 2008

A Dissertation
Submitted in Partial Fulfillment of the
Requirements for the Degree of
Doctor of Philosophy
at the
University of Connecticut
2014
Copyright by

Stephen Thomas Slota

2014
Doctor of Philosophy Dissertation

*Project TECHNOLOGIA:*
A Game-Based Approach to Understanding Situated Intentionality

Presented by
Stephen Thomas Slota, B.S., M.A.

Major Advisor __________________________________________________
Michael F. Young, Ph.D.

Associate Advisor _______________________________________________
Roger Travis, Ph.D.

Associate Advisor _______________________________________________
Scott W. Brown, Ph.D.

University of Connecticut
2014
ACKNOWLEDGEMENTS

In a work of this magnitude, there are many more individuals to thank than can ever be recognized in the span of two pages. The names and institutions listed below are a sampling of those whose assistance has made this research possible. To anyone I have regrettably been unable to include, please know that my gratitude extends to the infinite reaches of the universe and beyond. My sincerest thanks go out to all of you.

The State of Connecticut, University of Connecticut Graduate School, University of Connecticut Neag School of Education, University of Connecticut Two Summers Program, and Department of Educational Psychology for four years of financial and high-quality academic support.

JoAnn, Michael, and Shannon Slota for their unconditional love and guidance. They are the foundation for my success as an academic, teacher, and thinker, and their selfless contributions to my personal and professional growth are what have made me the person I am today. I hope I have made you proud.

Kelly M. Nelson for her kindness, thoughtfulness, and affection. May our adventures together ever grow, and may our Tardis data core be forever Dalek-free.

Michael F. Young for his considerable advisement, mentoring, consultation, and friendship. I will always consider our journey together “epic” (regardless of what Roger might think about my use of the word).

Roger Travis and Kevin Ballestrini for their collaboration, partnership, and contributions to the field of game-based learning. I would not be here if not for your willingness to partner with a young, starry-eyed biology teacher and fellow gamer.
Scott W. Brown for his advice, mentoring, and leadership within the Cognition, Instruction, and Learning Technologies program.

James E. McCarthy of Sonalysts, Inc. and James H. Watt of the University of Connecticut Department of Communications for their willingness to participate and provide feedback as readers on my dissertation committee.

W. Trent Hergenrader of the Rochester Institute of Technology for his consultation as a creative writing researcher and collaboration as a fellow gamer and friend.

Gabriel F. Byer-Alcorace, Andrea D. Kelley, and Lindsey K. Gervais for their advice, support, commiseration, and friendship within and outside of my doctoral process.

Benedict Lai, Beomkyu Choi, and Elijah Clapp for their partnership and collaboration as graduate assistants in the University of Connecticut Two Summers Program.

James Paul Gee and Sasha Barab of Arizona State University and Kurt Squire and Constance Steinkuehler of the University of Wisconsin-Madison for their critical work establishing and propagating educational gaming research within the learning sciences.

Walter S. Nakonechny Jr., Teresa Becker, Ross Sward, and Andrew K. Rockett for their incredible compassion, inspiration, and guidance as educational leaders and mentors.


Finally, the designers, programmers, artists, and technical staff—past and present—whose games have led a generation to discover fantasy and wonder in all aspects of life.
For Claire,
in hopes that I might bring your imagination and passion for learning to all who go without
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABSTRACT</td>
<td>i</td>
</tr>
<tr>
<td>ACKNOWLEDGEMENTS</td>
<td>vi</td>
</tr>
<tr>
<td>DEDICATION</td>
<td>viii</td>
</tr>
<tr>
<td>TABLE OF CONTENTS</td>
<td>ix</td>
</tr>
<tr>
<td>APPENDICES</td>
<td>x</td>
</tr>
<tr>
<td>LIST OF TABLES AND FIGURES</td>
<td>xii</td>
</tr>
<tr>
<td>FOREWORD</td>
<td>1</td>
</tr>
<tr>
<td>INTRODUCTION</td>
<td>3</td>
</tr>
</tbody>
</table>

## CHAPTER I

*Stories, Games, & Learning Through Play: A Situated Analysis of Narrative Affordances for Education*  

- **Introduction**  
  - An Alternative Approach to Narrative Research  
  - The Case for a Situated Framework for Understanding Narrative  

- **Three Levels of Narrative**  
  - Level 1: Narrative-as-Designed  
  - Level 2: Narrative-as-Perceived  
  - Level 3: Narrative-as-Social Organizer  

- **Narrative Co-Construction**  

- **Understanding Narrative as an Educational Tool**  

- **Project TECHNOLOGIA: A Study of Practomimetic Instruction**  
  - Investigative Methodology  
  - Qualitative Analysis  
  - Quantitative Analysis  

- **Categorizing the Affordances of Narrative**  
  1. Conveying Context, Chronology, & Content  
  2. Engaging & Motivating  
  3. Educating Intention & Attention  
  4. Creating Opportunities for Co-Action  
  5. Nurturing Creativity  

- **Limits of Interpretation**  

- **Conclusions**  

- **Chapter References**  

**ix**
# CHAPTER II

*Project TECHNOLOGIA: A Game-Based Approach to Understanding Situated Intentionality*

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Introduction</strong></td>
<td>52</td>
</tr>
<tr>
<td>Gaming in Education</td>
<td>52</td>
</tr>
<tr>
<td>Addressing Instruction with Situated Cognition</td>
<td>55</td>
</tr>
<tr>
<td>A Focus on Intentionality</td>
<td>57</td>
</tr>
<tr>
<td>Summary</td>
<td>60</td>
</tr>
<tr>
<td><strong>Project TECHNOLOGIA</strong></td>
<td>62</td>
</tr>
<tr>
<td><strong>Investigative Methodology</strong></td>
<td>63</td>
</tr>
<tr>
<td>Qualitative Analysis</td>
<td>66</td>
</tr>
<tr>
<td>Quantitative Analysis</td>
<td>67</td>
</tr>
<tr>
<td><strong>Results &amp; Implications</strong></td>
<td>71</td>
</tr>
<tr>
<td>Transfer</td>
<td>72</td>
</tr>
<tr>
<td>Interaction</td>
<td>77</td>
</tr>
<tr>
<td>Intentionality</td>
<td>82</td>
</tr>
<tr>
<td><strong>Limits of Interpretation</strong></td>
<td>87</td>
</tr>
<tr>
<td><strong>Conclusions</strong></td>
<td>89</td>
</tr>
<tr>
<td><strong>Chapter References</strong></td>
<td>91</td>
</tr>
</tbody>
</table>

# CHAPTER III

*World-Building 101: The Application of Contemporary Learning Theory in Game Design*

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Introduction</strong></td>
<td>102</td>
</tr>
<tr>
<td>Problem-Based Learning as a Foundation for Educational Gaming</td>
<td>104</td>
</tr>
<tr>
<td>The Intersection of Problem-Based Learning, Game Design, &amp; Education</td>
<td>106</td>
</tr>
<tr>
<td>TPACK &amp; TPACK-L</td>
<td>108</td>
</tr>
<tr>
<td><strong>Project TECHNOLOGIA</strong></td>
<td>112</td>
</tr>
<tr>
<td>TPACK-L as a Framework for Design</td>
<td>114</td>
</tr>
<tr>
<td><strong>Game Implementation &amp; Evaluation</strong></td>
<td>117</td>
</tr>
<tr>
<td>Qualitative Analysis</td>
<td>118</td>
</tr>
<tr>
<td>Quantitative Analysis</td>
<td>122</td>
</tr>
<tr>
<td><strong>Results &amp; Implications</strong></td>
<td>123</td>
</tr>
<tr>
<td>Interface, Narrative, &amp; Fostering Success</td>
<td>123</td>
</tr>
<tr>
<td>Learning Theory as Content &amp; Mechanic</td>
<td>126</td>
</tr>
<tr>
<td>TPACK-L in Action</td>
<td>129</td>
</tr>
<tr>
<td><strong>Limits of Interpretation</strong></td>
<td>133</td>
</tr>
<tr>
<td><strong>Conclusions</strong></td>
<td>135</td>
</tr>
<tr>
<td><strong>Chapter References</strong></td>
<td>137</td>
</tr>
</tbody>
</table>
APPENDICES

APPENDIX A
Summary of Project TECHNOLOGIA Narrative

APPENDIX B
Project TECHNOLOGIA Prompt Trajectory

APPENDIX C
Project TECHNOLOGIA Operative Thought Journal Main Page

APPENDIX D
Project TECHNOLOGIA Operative Thought Journal Codes

APPENDIX E
Project TECHNOLOGIA Gameplay Codes

APPENDIX F
Project TECHNOLOGIA Emergent Categorical Themes

APPENDIX G
Invitation to Participate

APPENDIX H
Participant Consent Form

xi
LIST OF TABLES AND FIGURES

CHAPTER I
Table 1: Stepwise approach to grounded theory analysis of Project TECHNOLOGIA data ........................................ 25
Table 2: Blackboard™ Posts Across Project TECHNOLOGIA ................................................................. 25

CHAPTER II
Figure 1: The perception-action loop associated with a situated worldview...................................................... 58
Table 1: Stepwise approach to grounded theory analysis of Project TECHNOLOGIA data ......... 70
Table 2: Blackboard™ Posts Across Project TECHNOLOGIA ................................................................. 70

CHAPTER III
Figure 1: The TPACK Framework (Koehler & Mishra, 2009) ................................................................. 109
Figure 2: Slota, Young, Choi and Lai’s (2014) proposed TPACK-L framework ............................................. 111
Table 1: Stepwise approach to grounded theory analysis of Project TECHNOLOGIA data ............. 121
Table 2: Blackboard™ Posts Across Project TECHNOLOGIA ................................................................. 121
FOREWORD

For as long as I can remember, I’ve considered myself a gamer: running around the woods playing tag with my neighbor, spending the night racing through *Super Mario Kart* or playing *The Legend of Zelda* with my sister, puzzling my way through a game of chess with my father, or sowing the seeds of chaos in *Dungeons & Dragons* with some of my closest friends. The spark of imagination—the thread of all storytelling—has brought me immeasurable joy through even the most perplexing and stressful moments of my life. Many of my gaming experiences, from collaborating with online peers to individually problem solving my way through a zombie-laden riddle, have unquestionably shaped the way I tackle challenges in the real world and enhanced my ability to grapple with the complex tasks I have faced as an artist, educator, and researcher.

It should come as no surprise, then, that I have often employed games as a way to inspire passion in students the same way it has been inspired in me for more than two decades. The engagement and intrigue that shine through as a child “plays” the curriculum are so compelling that I continue reflecting on them years after leaving the classroom. This effect was especially prominent among my lowest-tracked students—the academically unsuccessful or otherwise disenfranchised—and seeing how it prompted their creativity and critical thinking helped me learn even more from them than they likely learned from me.

This is what has led me to investigate the nature by which play can help educators—teachers, parents, administrators—reimagine what our school systems can and should look like. Over the last four years, I’ve taken on a situated view of thinking and learning, and I now see education as not simply what happens in a classroom but the sum of all agent-environment interactions that guide our perceptions, actions, and experiences with the world. My long-term goal has evolved from simply “fixing” schools to identifying how the playful learning that inspired
me in my youth can induce transfer, goal adoption, and engagement in others. I can only hope that this will inform the educational visioning necessary to produce our next generation of problem solvers, critical thinkers, and social collaborators.

To borrow from *Diablo’s* Cain, I’m optimistic that you’ll “stay a while and listen” so we might work together toward a brighter educational future. I appreciate your consideration of my work and encourage you to join the search for our shared game-based learning princess as we travel from one castle to the next.

Best wishes,

Stephen
INTRODUCTION

This study examined emergent player-player, player-instructor, and player-game perceptions, actions, and interactions throughout the implementation of a text-based, dual alternate reality-roleplaying game titled Project TECHNOLOGIA. Ideally, its findings will contribute to learning science by strengthening what is known about goal adoption, improving educational game design procedures, inspiring new programs of game-based learning research, and helping instructors better utilize games—text-based, video, and otherwise—at the classroom level. Achieving these goals would expand not just our understanding of games and gameplay but also the very nature of human thinking and learning (see Young et al., 2012; Young, Slota, and Lai, 2012; Young, Slota, Travis, and Choi, 2014).

Player-player, player-instructor, and player-game interactions were captured using Blackboard™ learning management system discussion boards, and individualized GoogleDoc-based Operative Thought Journals in which participants recorded their feelings, perceptions, ideas, and intentions across the game’s 24-week duration. I conducted a grounded theory analysis of all 274 discussion board posts and 14 Operative Thought Journals. The results are presented here as a multi-manuscript dissertation built around three distinct themes:

- **Chapter I** summarizes the literature on the intersection of story-telling, co-authorship, and game-based instruction to contextualize research on game design, transfer of learning, player-game-context interaction, and player intentionality.

- **Chapter II** summarizes student activity and performance from 24 weeks of Project TECHNOLOGIA play with respect to transfer, interaction, and intentionality, specifically.

- **Chapter III** discusses student perceptions of the game as well as the relationship between Project TECHNOLOGIA’s design based on Technology, Pedagogy, Content Knowledge, and Learning Theory (TPACK-L) and current approaches to commercial and educational game development.
In sum, the study provides: information about goal adoption in the context of a text-based, dual alternate reality-roleplaying game (i.e., *Project TECHNOLOGIA*); a qualitative grounded theory analysis of player-generated text; an evaluation of player ability to integrate educational technology, pedagogy, content knowledge, and learning theory; an investigation of player technology coordination competency in an simulated educational environment; points of intersection between instructional/game and educational/commercial design approaches; a report of potential narrative affordances for education; and implications for the on-going development of *Project TECHNOLOGIA* and similar game-based learning research.
CHAPTER I

Stories, Games, & Learning Through Play:
A Situated Analysis of Narrative Affordances for Education

Abstract: Stories are the mechanism through which humans construct reality and make sense of the world around them. Yet, research on the positive effects of narrative in formal and informal learning environments are quite variable, and the relevance of narrative to educational psychology is not well understood. Identifying precisely how narrative intertwines with human experience of the lived-in world requires the application of a situated cognition framework to understand recipient-content-context interactions as dynamic and co-determined. To begin unpacking this issue, a narrative-structured, game-based learning program, Project TECHNOLOGIA, was used to target in-context, on-the-fly dialogic interactions between narrative “producers” (i.e., instructors) and “recipients” (i.e., participating students). Results indicate that there may be value in pursuing a narrative approach to instruction for complex social, cultural, and intellectual issues such as Project TECHNOLOGIA’s content concerning educational administration initiatives within a K-12 school district. Recommendations for further research are provided.

For millennia, stories have been used to frame human existence, learning, and culture. In Sartre’s (1938) words, “a man is always a teller of stories. He lives surrounded by his own stories and those of other people. He sees everything that happens to him in terms of these stories, and he tries to live his life as if he were recounting it” (pp. 61). Stories are, on the whole, the mechanism through which humans construct reality and make sense of the world. Yet, research aimed at reviewing and analyzing the positive influence of narrative in formal and informal learning environments is quite variable, and despite thousands of years of oral storytelling tradition, the relevance of narrative to theories of learning is not well understood or researched.

In response, this paper aims to reconcile what is assumed with what is known about the psychological underpinning of narrative. By highlighting the results of a narrative-structured, game-based learning program, Project TECHNOLOGIA, it addresses two specific questions regarding narrative utilization for classroom instruction:

1. How can narrative be optimally characterized with regard to impact on learning?
2. What are the specific affordances of storytelling and narrative structure for supporting classroom learning?

If humans share knowledge, encourage investigation, and promote creative acts through narrative, identifying the connection between story “producers” and “recipients” would likely facilitate pedagogical design writ large. As established below, taking a situated view may further the existing framework through which narrative has been described in the past and help describe the potential of narrative application for shaping learner understanding, curricular goal adoption, and transfer from classroom to applied settings.

*An Alternative Approach to Narrative Research*

For decades, cognitive scientists have suggested that thinking and learning are representational, symbol-driven processes attributed to an internal mind and recorded by synaptic neurochemical exchanges (e.g., Miller, 2003; Vera and Simon, 1993). However, given the extent to which experience with the lived-in world affects goal adoption and behavior, the leap from a biologically and chemically-driven explanation of thought (e.g., Skinnerian behaviorism) to the deeply philosophical concept of a mind (e.g., Descartes) seems somewhat disjunct. To compare the brain to computer hardware (e.g., making use of internal symbols and representations via schematic cataloging) set in a disembodied, intangible mind dilutes the granular, individualized interactions of particular people within particular contexts acting on particular life experience sets (Dreyfus, 1992; Varela, Thompson, & Rosch, 1991). As a result, it may be beneficial to conduct future learning science research with an eye toward the influence of individual life-worlds on perception and action (i.e., situated cognition; see Barab and Roth, 2006; Young, 2004).

Storytelling and gaming are two areas where adopting this kind of ecological perspective might be especially helpful for delineating how and why learning occurs in particular formal and
informal educational contexts. Much of the extant literature concerning stories and games is rooted in information processing and schema theory, and while this has been helpful for the purposes of deconstructing relationships between varying narrative elements (e.g., Burke’s [1945] pentad of story elements and Bruner’s [1991] 10 defining characteristics of narrative), it has also been limited in addressing the complex nature of author-reader-environment interaction. Schank (1977; 1989; 1991; 1995; 2006), for instance, argued that people create and use cognitive scripts to anticipate events and recall them based on story frameworks, planning actions around scenarios they have prospectively played out in anticipation of them happening in the future—a rough equivalent of mentally “playing through” possible conversations while driving in the car or lying in bed prior to sleep. However, if these stories are not grounded in the ontological descent of constraints of the natural universe (i.e., perception and action in the lived-in world), they are inherently dissociated from reality: an internal, non-measurable mind versus the actual, measurable world. Schank’s description does not account for the intersection of intentionality, context, and individual action (i.e., skills and abilities used to affect the world) which overlooks the external constructs that govern how and why particular stories, sequences of events, and contexts make sense. Altogether, this limits potentially valuable insights into why individuals think, set goals, and act in the ways they do.

Likewise, stories, games, and other forms of narrative are rendered insignificant if the audience (i.e., one or more recipients of the given narrative) lacks the worldly experience to understand their underlying meaning in-context—for instance, when a young child attempts to read and interpret Tolkien’s (1977) *The Silmarillion* or play and comprehend Irrational Games’ (2007) *BioShock*. Narrative and environmental circumstance are connected by the relationships formed not just between the narrative’s producer and end user but also the producer’s life-world,
the end user’s life-world, and the environment or medium in which the narrative is embedded. Even if the producer has written something with a specific instructional goal in mind, as with TaptoLearn’s (2013) *Math vs Zombies*, the end user’s prior experiences fundamentally inform—or confound—the author’s intended interpretation. For example, a student playing *Math vs Zombies* might have a goal to see how close she could let the zombie get before transforming it, thwarting the designer’s goal to enhance math response speed. A particular reader with particular life experiences might similarly interpret Hemingway’s (1952) *The Old Man and the Sea* as an irony or comedy rather than a personal statement about Hemingway’s philosophy of religion, life, identity, and death. This suggests that taking an alternative, ecological approach to studying stories and games could prove useful in defining whether and to what extent narrative holds value in education—a means of more firmly establishing how writer, reader, and context meet to organize the phenomenon known as “telling” (Schwartz & Bransford, 1998).

**The Case for a Situated Framework for Understanding Narrative**

Humans exist with particular long-term intentions that govern and fulfill particular biological functions (e.g., survival, reproduction) across the space-time of their lives (Barab & Roth, 2006; Young, 2004). The dynamic emergence of new goals establishes a goal space within which writers (i.e., producers) and readers (i.e., recipients) can act toward achievement of those objectives. Additionally, goal spaces control producer and recipient behaviors as those individuals perceive and act—in the case of a writer, producing a novel, essay, or other story on a moment-to-moment basis, and in the case of a reader, reading, considering, and acting on his understanding on a moment-to-moment basis. The establishment of a goal space sets the boundary constraints on possible creative actions that producers and recipients can take. There is an ontological descent of possibilities ranging from: 1) logically possible actions, to 2) physically possible actions, to 3) the
constraints of the natural world, to 4) constraints of the world as it exists that day, and finally to 5) constraints of the current context as it exists at the moment. Within this ontological descent, the boundaries of a particular producer or recipient’s thinking and behavior is set, establishing a situated framework for his or her interaction with a particular narrative.

In the early 1990s, the Cognition and Technology Group at Vanderbilt (CTGV) (1990; 1993; 1994) capitalized on this situated framework through a research program called *The Adventures of Jasper Woodbury*. *Jasper* used narrative in the form of a 17-minute video to create a context for middle school mathematics, strategically crafting stories from everyday life such that middle schoolers could provide various solutions to the kinds of problems that arise when grocery shopping, traveling, school fundraising, and scheduling the day. CTGV concluded that adding narrative structure (e.g., beginning-middle-ending story grammar) to mathematics problems could enable students to utilize their everyday knowledge in the context of the middle school math curriculum, including distance-rate-time problems, area and volume computation, compound decimals (e.g., strange combinations of decimals and fractions in a gas station sign showing the price as $3.98\frac{9}{10}$), and methods for wisely retrieving information external resources (e.g., using the timeline of the story to access a video database).

These “anchored instruction” stories enabled non-traditional students to contribute to mathematical discussions by using their everyday knowledge and aid in a collaborative problem-solving process. They described the value of narrative as engaging students’ everyday cognition and tapping into fundamental ways through which humans detect and recall information in meaningful ways. However, this use of stories in the classroom was also viewed as non-traditional teaching that required risk-taking, problem solving, and creativity on the part of participating teachers. Teachers who were accustomed to telling students what they needed to know prior to
challenging them with complex problems at the end of a unit were instead forced to take an opposite approach: immersing students in an ill-defined problem to be experienced as initially intractable without full understanding of the mathematics involved, and then using the problem as a “time for telling” about numbers, ratios, and rates. This helped shape a shared experience among students that warranted learning more about the math or science content identified in the school curriculum. It also required teachers to creatively respond to multiple groups simultaneously working on the anchor problem in multiple ways, drawing from the raw materials of student work rather than from a prepared script. In the end, CTGV’s research demonstrated that it was possible to make 17-step math problems transferable from the classroom to the real world by wrapping them in narrative that drew upon everyday knowledge, nurtured creative thinking, and encouraged risk-taking.

Importantly, though, no single narrative could provide an ideal context for all learners, and CTGV again drew from contemporary learning theory to develop a strategic approach—a “generator set”—that established pairs of stories designed to highlight the invariance of mathematical concepts across varying scenarios. Early iterations failed when built around the assumption that students could simply analyze and compute in their heads to understand the content (e.g., cognitive analysis, representations, mental computation). Instead, the developers needed to recognize the importance of direct student experiences within and external to the classroom, including the ways in which students are driven by larger goals and moment-to-moment intentions. Jasper’s success ultimately hinged on age-appropriate humor, character development, surprise, and other techniques of gifted writers applied in conjunction with a thorough understanding of mathematical content and a sense of how work in classrooms unfolds. In short,
CTGV needed to recognize that the world was not in the students’ heads; their heads were in the world of the classroom (Kirshner & Whitson, 1997).

Papert’s Logo and Apple’s Hypercard similarly pushed the boundaries of situated learning environments (Papert, 1980; 1993; 1997). While these projects eventually collapsed (for reasons mostly unrelated to their theoretical foundations; see Slota, Young, and Travis, 2013), they highlighted many of the benefits of taking an individual-content-context perspective during the pedagogical design and research. Current narrative and game-based learning researchers would do well to continue this line of work to bring cohesion to what is already known about human thinking and learning in-context. Vitally, this process will require the redefinition of what narrative is, what it represents, and the affordances it has for formal and informal learning. The following section frames a situated response to these questions and lays the foundation for parallel qualitative research on narrative for education. By organizing assumptions, hypotheses, and current study of the subject, I hope to carve out a clearer trajectory for future quantitative experimentation.

**Three Levels of Narrative**

Narratives are traditionally organized around properties thought to be unique within specific categories—these might include genre (e.g., horror, comedy, tragedy), tone (e.g., melancholy, hopeful), message (e.g., morals, lessons), or presentation type (e.g., book, stage production, film, video game). However, this organizational process generally ignores the situated and personal nature of producer-narrative and recipient-narrative interactions, assuming that a single narrative can only be understood through the producer’s original life-world lens. Even if the producer has a particular goal or set of goals in mind when writing his or her story, it would be impossible to account for every experience and perspective a recipient might bring to their reading of that story. Shakespeare’s *Hamlet*, for example, could take on an entirely different meaning to a
recipient who has no understanding or respect for family, no care for monarchical hierarchy, or suffers from sociopathy. From his perspective, the play might instead be interpreted as a statement on boredom, humor, a prescription for revenge in real life, or nothing in particular.

This reinforces the primary complication with how narrative is treated in the cognitive science literature, especially in the realm of game-based learning circa 2014. More often than not, the games utilized for the purposes of research projects are special implementations that are never made available for future exploration and lack in-depth descriptions of mechanics, objective alignment, and the development process (Young et al., 2012). To the extent cataloguing is incorporated into publications, the lack of consistent definitions for terms like “gamification,” “simulation,” and “educational game” has made it extraordinarily difficult to determine exactly what role a particular game can effectively serve in any one classroom (Slota & Young, 2014). As a result, much of the information about game narrative and functionality has been inadvertently omitted.

To counteract this problem, it would be prudent to refine and standardize narrative cataloguing across all media research. Yet, knowing that the organization process as currently utilized is ineffective, generalization based on perceived “unique” narrative properties would be unduly limiting. It would benefit researchers to focus instead on the nature of narrative interactions—that is, how narrative is perceived and acted upon by individuals—rather than emphasizing superficial differences between individual stories, genres, or story structures. The following section describes one way this can be accomplished by dividing narrative into three distinct levels of analysis that are fundamentally consistent across all genres, formats, and more.
**Level 1: Narrative-as-Designed**

When an author begins writing a text, she is guided by her intentions and experiences as part of the lived-in world. Her life-world informs a particular writing goal and guides the conveyance of a particular message, theme, or idea by way of literary structuring, diction choices, and formatting decisions. For instance, she may tell the story of a knight’s quest to rescue his betrothed from a dragon to encourage the reader to share a message of love and heroism—something that could be considered Narrative: Level 1, the narrative-as-designed. This can be accomplished directly, as with contemporary social media games and apps that ask story recipients if they would like to share their progress or discuss story content via social media websites (e.g., Goodreads, *FarmVille*), or indirectly, as with stories built to unfold as part of the recipient’s interactive experience (e.g., choose-your-own-adventure books and games like *The Cave of Time*, *Star Wars: Knights of the Old Republic*, *Mass Effect*, and Telltale Games’ *The Walking Dead*). These two approaches define the primary purpose of the narrative-as-designed: to convey the producer’s intentions to a particular audience and encourage receipt of an intended message.

**Level 2: Narrative-as-Perceived**

Even if the narrative-as-designed is well-written, Narrative: Level 1 holds little or no weight if members of the receiving audience re-shape the story based on their own situated goals and experiences, including unintentional misinterpretation, willful misdirection when describing the story to others, or modifying the story in subsequent editions or cross-media (e.g., book-to-film, game-to-book adaptations). Returning to the “knight and dragon” example above, a misanthropic teen might pick up the author’s work and read it under the assumption that the narrative-as-designed is a commentary on the triteness and unrealism of fairy tales. Perhaps he has recently suffered through a relationship break-up and believes that idealistic views of heroism and
romance are overrated. Being inseparable from his reading of the story, his life-world will inevitably shape the lens through which he interprets the author’s writing and influence the way he describes any underlying moral or thematic value. This defines Narrative: Level 2, the narrative-as-perceived.

Given the frequency with which narrative has been used for educational purposes—from Plato to Shakespeare and classrooms to contemporary news media—it is surprising that existing cognitive science literature does not address the divide between the producer’s narrative-as-designed and recipient’s narrative-as-perceived. In order for desired instruction to occur, for instance, a producer would need his audience to understand and interpret the narrative-as-designed as planned. Otherwise, recipients may transfer the narrative-as-perceived in such a way that they distort the producer’s meaning, or worse, perpetuate misapplication among others. Both Burke (1945) and Bruner (1991) framed the structure of such a producer-recipient relationship, but neither analysis captured the situated nature of recipient insight. Instead, they emphasized the structural organization techniques employed by writers as though the producer-recipient relationship was entirely unidirectional (i.e., writer-to-reader; Narrative: Level 1). Understanding this relationship as bidirectional may help future producers develop an optimal generator set for conveying particular underlying morals, values, and ideas, something that could dramatically shape the development of narrative learning experiences for education.

**Level 3: Narrative-as-Social Organizer**

Narrative-as-perceived (i.e., Narrative: Level 2) has the potential to reinforce or mutate a producer’s desired message. Both outcomes can be intensified as a function of social amplification—that is, the more recipients who interact with and around a given narrative, the greater the distortion (e.g., crowd sourcing, playing “telephone”). Importantly, though, the social
organization that occurs in and around stories can foster the creation of entirely new, co-constructed narratives that exist exclusive of the original body of content. This can be referred to as Narrative: Level 3, or narrative-as-social organizer.

Even the most mundane stories have the potential to spawn peripheral social groups with shared goals and intentions. For example, a writer could produce the following one-sentence story: “The man ate an apple.” The narrative, by itself, could be presented by the producer to a group of recipients for further consideration. Emergent questions could drive discussion about the event being described: “Why did the man eat the apple?” “Why did he only eat one apple?” “Why did he choose to eat an apple rather than a banana?” “Is there an underlying message about how ‘an apple a day keeps the doctor away’?” This puts recipients in the position to write and share analyses of the story, build on the original (e.g., fan fiction), and create clubs, online communities, and other organizations where they can chat, debate, and evaluate one another’s contributions to the man-apple narrative. Additional, tangential narratives can emerge from community discussion and seed new stories that are wholly unrelated to the original. Perhaps two “Man-Apple Story Club” members get into an argument over dinner, and the ensuing drama serves as a source of intrigue for other club members to share amongst themselves or outside of the group. Though the man-apple narrative might seem pointless or unimpressive to some observers, it still holds the potential to ground much more impressive, co-constructed, external narratives.

**Narrative Co-Construction**

The above example raises an important point about the nature of co-constructed storytelling. Education literature traditionally approaches narrative production and storytelling as a unidirectional event born from an individual producer, yet narratives are seldom, if ever, under the control of one person. Even private journals are the end result of social collaboration over time:
other individuals taught the writer how to write, helped shape his life-world, and demonstrated the affordances of journaling. The same writer, returning to his work days, months, or years later, brings new understanding to what was originally written and socially co-constructs the journal narrative as a recipient and co-producer. This implies that a single narrative, even if written in social isolation, is actually a social, collaborative, non-replicable, and situated experience. The level of complexity simply grows as more individuals join to sequentially and iteratively produce a given work (e.g., GoogleDocs, web forums, film/stage performance production, designing a world in Minecraft or Terraria).

When teachers and students co-produce particular narratives, especially those directly tied to curricular goals, outcomes may be unpredictable but support creativity, critical thinking, and problem solving in ways not typically seen in traditional classrooms that use only fixed narratives like books. This is not to say that traditional instruction is unilaterally organized as producer-to-recipient, but explicit co-construction can provide a richer educational experience than an individual teacher utilizing direct instruction. What remains to be understood psychologically and abstracted for principled instructional design are the specific affordances that optimally connect interactive storytelling with precise delivery mechanisms and coverage of curriculum. It already seems clear that a trend toward collaborative writing has the potential to enrich 21st century skill development for the betterment of higher education, businesses, and broader culture. To further that goal, researchers must identify specific affordances of social narrative production and better describe the interactions between producer, recipient, and context in order to move practical application forward.
Understanding Narrative as an Educational Tool

Travis (2010) suggested that storytelling, games, books, stage shows, and other media should be viewed as sub-sets of a broader type of narrative. This classification, *practomime* (Travis, 2010), does not distinguish between individuals participating in a group presentation, acting in a musical, or playing a video game. Instead, any agent-environment interaction that results in a particular behavioral demonstration is taken as comparable to all other agent-environment interactions resulting in particular behavioral demonstrations. In other words, all performances driven by recipient-narrative-context interaction are equal under a broader umbrella (i.e., practomime).

Travis’ perspective has especially substantial implications for the ways in which games can be applied in traditional educational settings. If, for instance, an instructor pairs game and learning objectives at a 1:1 ratio—that is, every in-game objective is identical to a particular learning objective counterpart—the game’s narrative can serve as the primary vehicle for content delivery. Here, Narrative: Level 1 (e.g., the “story” of covalent bonding) and Narrative: Level 2 (e.g., the player’s takeaway from the particular gaming experience) are compatible by design and capable of meaningfully shaping social collaboration in Narrative: Level 3 (e.g., affinity groups that deconstruct, evaluate, and critique gameplay). This can further afford the arrangement of richly authentic contexts fit for deconstruction, helping learners visualize how their developing skills can be applied both in and outside of the classroom (i.e., transfer).

By offering the flexibility to customize pedagogy and mechanics without being caught up in unhelpful conversations about individual genres, tools, or games (see *Three Levels of Narrative*), practomime exemplifies how narrative can be used to develop, support, and explore critical thinking and problem solving. It enables educators to construct narrative-centric learning
environments that serve as co-constructed sandboxes-on-rails (i.e., settings through which students engage in open inquiry but are continually guided back to the governing learning objective by a more knowledgeable other). Perhaps even more valuably, it is not burdened by traditional assumptions about classroom rules and parameters that emphasize the producer’s (i.e., instructor’s) role over and above that of the recipient (i.e., students). Rather, it organizes a “time for telling” (Schwartz & Bransford, 1998) by grounding student-student and student-instructor dialogue in a narrative anchor that bridges the gap between academic and real world activities (e.g., test-taking and task performance, respectively). In theory, this means optimizing narrative for use in K-12 and higher education is not be as ambiguous as educational history would imply—it is instead an empirical question of how and to what extent practomime can be applied in the classroom.

**Project TECHNOLOGIA: A Study of Practomimetic Instruction**

In service of fostering cross-context critical thinking and researching the relevance of narrative in game-based learning environments, the staff of a large, public university Educational Technology graduate program developed a 24-week, dual alternate reality game (ARG)-roleplaying game (RPG) titled *Project TECHNOLOGIA*. Its plot follows the administrators of a fictional space vessel, the Remmlar Array, headed by Duncan Matthau and his assistants, Rheegan Hamilton and Biff Wallace (Appendix A). Over the course of six episodes (i.e., content units) students are tasked with envisioning, designing, and stabilizing a new educational system through the wise integration of learning technologies (as defined by the International Society for Technology in Education [ISTE] 2014 standards; see ISTE, 2014). This makes the target objective—based on balancing the needs and desires of a K-12 school district—the same from both narrative and academic perspectives (Appendix B).
The program uses a combination of familiar game mechanics (e.g., roleplaying, interaction with non-player characters) and the Blackboard™ learning management system to guide players toward target learning objectives and perspectives favorable for telling a story about their learning as it unfolds. Its organization takes advantage of narrative in two distinct ways: first, players perform as “operatives” on a mission to save the world by fulfilling program-level learning objectives (e.g., visioning and implementing district-wide technology initiatives), and second, they perform as characters (e.g., school district technology coordinators) on a mission to save the game world, also by fulfilling program-level learning objectives (see also Slota, Ballestrini, and Pearsall, 2013). Additionally, they are encouraged to step out of the game to “tell” about their performances in the form of self-evaluation and group discussion—an intersection of Narrative: Levels 1, 2, and 3. This multi-performance tiering attempts to capture the potential benefits of practomime by encouraging metagame activities like the discussion of game mechanics and successful strategies for dealing with particular problems (i.e., Narrative: Level 3), ideally feeding back into reflection behaviors, academic achievement, and transfer.

**Investigative Methodology**

Between February and July 2014, 14 Educational Technology Master’s students were invited and agreed to participate in Project TECHNOLOGIA, promoted as a story-driven game designed to help them more deeply engage with program content (12 female, 2 male; 12 Caucasian, 2 Asian-American, 1 Hispanic; aged 22 to 65 years). All of the participants were gainfully employed as practicing educators throughout the game’s 24-week duration, and their collective career backgrounds included elementary, secondary, and post-secondary positions in rural, urban, and suburban districts. Though their experience with gaming ranged from little to none, they expressed familiarity with “choose your own adventure” stories and roleplaying as a form of
performance (i.e., acting). This made the group an ideal sample population insofar as it minimized the likelihood that prior ARG/RPG involvement would conflict with the story and mechanics utilized in Project TECHNOLOGIA. Additionally, the participants’ existing relationship with the Master’s program instructional staff would make it easier to maintain positive player-instructor interactions, and information pulled from the discussion forum could directly inform their related coursework as Educational Technology graduate students (Suter, 2012).

At the game’s outset, the players were randomly sorted into three teams—two groups of five and one of four. All teams were guided by separate instructional leaders whose responsibilities included posting new Project TECHNOLOGIA episodes based on a pre-established schedule, responding with non-player character actions and dialogue as needed, and maintaining a focus on the ISTE standards. The instructional leaders were comprised of two advanced doctoral candidates and one university faculty member, all with formal training in cognition, instruction, and learning technologies and a minimum of four years’ experience working with the overarching Educational Technology Master’s degree program. Each Project TECHNOLOGIA participant was assigned a particular avatar/character that could speak, “think” (i.e., give third-person descriptions of avatar thoughts), and act within the story space (i.e., Blackboard™ discussion forums). Additionally, the participants were given login credentials for individual GoogleDoc-based Operative Thought Journals that could be used as repositories of personal perceptions and feelings about the game, outside influences on participation, and in- or out-of-game goals (Appendix C).

Player assessment was continuous, embedded, and formative based on a combination of in-game dialogue, player-player and player-instructor interactions, and the Operative Thought Journals. After viewing an objective-based prompt posted by the instructional leader, the students were expected to collaborate with their teams to act within the gamespace. This allowed the
instructional leaders to evaluate skills like collaboration and visioning (ISTE, 2014) with emphasis on the complex challenges facing educational technology specialists. Additionally, it maintained focus on real world application by placing learners in complex, problem-rich contexts that required them to employ creativity, intellectual risk-taking, and self-evaluation of learning.

Throughout implementation, the instructional leaders used player Blackboard™ posts (i.e., character behaviors, thoughts, actions written over the course of the story) to guide story progression (e.g., non-player character dialogue, activities). The Operative Thought Journals, by contrast, were withheld from the instructional leaders to prevent player opinions from unduly influencing the story’s structure and/or content before it had been experienced in its entirety. Though the in-game learning objectives were identical across participant groups, story details (e.g., non-player character phrasing, diction choices) varied slightly based on the decisions made by each team (e.g., attacking a non-player character vs. assisting a non-player character) and/or the instructional leader’s discretion (i.e., instructional approach and posting frequency). This was controlled through the use of pre-written “minus,” “neutral,” and “plus” versions of each in-game prompt, designed to anticipate particular types of player activity (e.g., helping vs. attacking a non-player character). Differences between the “minus,” “neutral,” and “plus” variants were primarily superficial (e.g., characters responding with different facial features, slightly different phrasing of ideas) and used to scaffold the participants closer to the primary program objectives (i.e., “Visioning” as defined by the NETS-C/ISTE standards). “Minus” variants were posted in response to what the instructional leader considered negative behaviors, distractions, or clear lapses in activity; “neutral” variants were posted in response to what the instructional leader considered adequate group progress toward the current learning objective; and “plus” variants were posted in response to what the instructional leader considered exceptional progress toward both the current
learning objective and overarching mission (i.e., Project TECHNOLOGIA as a whole). This highlighted how player actions (or lack thereof) had consequences as a function of storytelling but did not distract from the game’s chief purpose (i.e., providing an opportunity to apply the NETS-C/ISTE standards).

Qualitative Analysis

In order to explore how and to what extent particular narrative elements contribute to particular thoughts and responses among story recipients (Young et al., 2012; Young, Slota, & Lai, 2012), I elected to utilize grounded theory analysis (Glaser, 1992; 1998) structured using an interpretation theory framework (Potter & Wetherell, 1987; Rennie, 2007; Thomas, 2003; Young et al., 2012). The co-written narrative’s organization (i.e., threaded discussion) made parsing and analyzing data fairly straightforward given that all text was pre-isolated into separate contributions by individual participants (Cheek, 2004). This also allowed for the maintenance and evaluation of important cues, comments, and player-player feedback present within the original gamespace (e.g., ways to improve future performance, instances of real or perceived failure, points of critical thinking—any data that could be extrapolated into broader categories) without introducing ambiguity as to which participant wrote each portion of the story (Bakhtin, 1981; Foster & Ohta, 2005). To facilitate data triangulation, the investigator could use the Operative Thought Journals to track individual differences in participant thinking and learning by comparing thought journal content with corresponding in-game activities (identified through mission number, time, and date of entry).

Though there is no singularly correct way to conduct a grounded theory analysis, several steps tend to be consistent across studies in which it has been applied (e.g., Shaw and Bailey, 2009). These allow the investigator to make inferences about social interaction based on statement
phrasing, the use of particular terms, and the types of responses yielded from particular questions, statements, or arguments (Thompson, 1988), thus establishing ways in which complex social behaviors (e.g., group learning) manifest in real world contexts (Berger & Luckman, 1967; Lave & Wenger, 1991; Vygotsky, 1978). To that end, the investigator made several assumptions prior to qualitative data analysis. Specifically: 1) interaction is favored over outcomes and products; 2) all data must be analyzed by an individual (i.e., the researcher) rather than a machine or piece of software; 3) subjects must be studied in-context, implying the need for triangulation (in this case, understanding student situations and the context for communication); 4) data analysis centers on interpretation and the emergence of meaning; 5) there is inherent orientation toward constructing hypotheses, concepts, and theories from details rather than using details to confirm or deny existing hypotheses, concepts, or theories; 6) all interactions are formed as the result of dialogue and meaning will come as a result of player-player and player-instructor interaction (Bakhtin, 1981; Creswell, 1994; Hathaway, 1995; Merriam, 1988). This process made it possible for the investigator to catalog how and why participating players made particular choices with respect to storytelling, co-constructed particular solutions, and/or adopted particular strategies to overcome in-game challenges. Additionally, it afforded a richer interpretation of the data than might have been possible using a predominantly quantitative evaluation of player progression toward a particular dependent variable (e.g., achievement, motivation).

Data analysis unfolded as a nine-step process (Table 1) beginning with the import of all 274 Blackboard™ discussion posts (Table 2) and 14 Operative Thought Journals into QSR NVivo 10 (approximately 44,400 words excluding the pre-written, episodic narrative prompts). Given the contextual differences between the two (i.e., co-constructed in-game vs. individual/internal, respectively), the investigator initially chose to treat them as mutually exclusive resources in order
to identify common word, phrase, and concept usages unique to each (e.g., “collaboration,” “goal,” “I would like to…”). Due to the sheer volume of player-generated content embedded in both discussion board posts and Operative Thoughts Journals, the data was further parsed into composite idea units comprised of individual comments, statements, and/or questions. These idea units were occasionally shorter than a full sentence but never more than three sentences in length. Importantly, they were analyzed in the presence of the preceding and following idea units to minimize the loss of vital, context-dependent information (e.g., author tone, intention).

The investigator tracked commonalities between idea units throughout the reading process via open coding (Glaser, 1992; 1998). Refinement with QSR NVivo 10’s coding toolkit resulted in 11 unique nodes across the 14 Operative Thought Journals (Appendix D) and 11 across the Blackboard™ discussion posts (Appendix E). These nodes were re-applied to axially code all collected data and identify any categorical themes emergent across both sources (i.e., Operative Thought Journals examined alongside corresponding in-game dialogue) (Appendix F) (Strauss & Corbin, 1990; 1998). This laid a foundation for unpacking how and why particular individuals interacted with the narrative in particular ways, feeding back into the investigator’s goal to determine how narrative can be optimally characterized within the field of educational psychology and define the specific affordances of storytelling and narrative structure for supporting classroom learning.
Table 1. Stepwise approach to grounded theory analysis of Project TECHNOLOGIA data.

1. Import participant data from Blackboard™ (i.e., in-game posts) and GoogleDocs (i.e., Operative Thought Journals) into QSR NVivo 10
2. Scrub identifying information (e.g., names, school districts) from imported data, assigning a randomly generated five-digit identification number to each participant
3. Read all discussion posts and Operative Thought Journals within their exclusive contexts (i.e., as separate datasets)
4. Identify common word, phrase, and concept usage within each dataset via inductive open coding
5. Record trends in word, phrase, and concept usage as unique nodes within QSR NVivo 10
6. Use established nodes to review and axially code data across both datasets, first individually and then taken as one
7. Record emergent categorical themes as identified through the axial coding process
8. Establish recommendations for future research based on emergent categorical themes
9. Present findings to participants in service to data/analysis triangulation

Table 2. Number of Blackboard™ Posts Across Project TECHNOLOGIA episodes.¹

<table>
<thead>
<tr>
<th></th>
<th>1.1</th>
<th>1.2</th>
<th>1.3</th>
<th>2.1</th>
<th>2.2</th>
<th>2.3</th>
<th>3.1</th>
<th>3.2</th>
<th>3.3</th>
<th>4.1</th>
<th>4.2</th>
<th>4.3</th>
<th>5.1</th>
<th>5.2</th>
<th>5.3</th>
<th>6.0</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1</td>
<td>6</td>
<td>5</td>
<td>8</td>
<td>6</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>2</td>
<td>3</td>
<td>5</td>
<td>9</td>
<td>5</td>
<td>74</td>
<td></td>
</tr>
<tr>
<td>Group 2</td>
<td>6</td>
<td>9</td>
<td>19</td>
<td>12</td>
<td>8</td>
<td>5</td>
<td>9</td>
<td>6</td>
<td>4</td>
<td>2</td>
<td>7</td>
<td>7</td>
<td>6</td>
<td>8</td>
<td>8</td>
<td>122</td>
<td></td>
</tr>
<tr>
<td>Group 3</td>
<td>5</td>
<td>7</td>
<td>3</td>
<td>9</td>
<td>3</td>
<td>11</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>2</td>
<td>7</td>
<td>7</td>
<td>4</td>
<td>78</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>17</td>
<td>21</td>
<td>30</td>
<td>27</td>
<td>15</td>
<td>20</td>
<td>14</td>
<td>10</td>
<td>14</td>
<td>14</td>
<td>13</td>
<td>11</td>
<td>20</td>
<td>24</td>
<td>15</td>
<td>274</td>
<td></td>
</tr>
</tbody>
</table>

A second researcher—the university faculty member assisting as a Project TECHNOLOGIA instructional leader—reviewed approximately 20% of the total data using the coding scheme generated through the primary investigator’s open and axial coding. This independent evaluation of code consistency, utility, and overall trustworthiness (i.e., peer debrief; see Morse, Barrett, Mayan, Olson, and Spiers, 2002; Spillet, 2003) yielded roughly 74% overlap with the primary investigator’s original code assignments. Inconsistencies between the two were used to review the primary investigator’s findings and identify how code clarity, precision, and specificity could be improved. The process resulted in minor modifications to a small number of code definitions, but no codes were judged in need of elimination or replacement. Combined with

¹ It is worth noting that while Groups 1 and 2 produced nearly the same number of discussion posts throughout Project TECHNOLOGIA, Group 3 produced approximately 50% more. All groups were comprised of teachers with similar experiences, workloads, and external responsibilities, and post content between the three groups was roughly similar in quality. This suggests that there may have been a quirk with Group 3 participation or an indirect motivating effect of Group 3’s instructional leader—the university faculty member. This question went unanswered during triangulation and debriefing but will be addressed in future implementations of the game.
participant member checking at the investigation’s conclusion, data collection, parsing, and interpretation were determined to be qualitatively reliable within the scope of the study.

**Quantitative Analysis**

As a combined result of the study’s limited sample size (n=14) and the lack of a standardized benchmark assessment for the NETS-C/ISTE standards, it was not possible to take a predominantly quantitative approach to examining correlations between particular narrative elements and participant learning in *Project TECHNOLOGIA*. A conservative estimate calculated via GPower 3.0 suggested that 200-300 participants would be needed to make any quantitatively valid and reliable claim regarding knowledge gains attributable to game participation. As a substitute, the researcher sought to use student grades, evaluations, and assignment completion rates to triangulate individual differences between player success and failure rates with respect to in-game and out-of-game (i.e., Master’s degree program) learning objectives. However, because all participants completed the graduate program with a grade point average (GPA) at or very near 4.0 with zero missed assignments, quantitative e-portfolio and grade data produced a ceiling effect—there would be no correlation between program-level achievement and the knowledge, attitudes, or behaviors that emerged as a product of gameplay since all players achieved roughly equal GPAs. Consequently, the investigator focused on an entirely qualitative analysis that could be used to frame future quantitative investigations (e.g., studies of player achievement, motivation, goal adoption).

**Categorizing the Affordances of Narrative**

Like CTGV’s *The Adventures of Jasper Woodbury*, *Project TECHNOLOGIA* revealed that no single narrative can be expected to have universal appeal or invoke the same reaction among different individuals (see CTGV, 1990; 1993; 1994). After all, there is no general experience set
an audience inherently brings to a given narrative—a particular story read at a particular time by a particular person in a particular environment will be perceived and utilized across the space-time of that reader’s particular life-world (e.g., Young, Slota, Travis, and Choi, 2014). However, the nature of thinking and learning (as governed by physiology, neurobiology, and genetics) predisposes humans to perceive a broad set of affordances grounded in narrative, and some of those affordances have become more obvious as a result of Project TECHNOLOGIA’s implementation.

This section describes Project TECHNOLOGIA’s results and highlights how narrative affordances emerge and function in situ for anchored, problem-based, and game-based education. While by no means a wholly comprehensive list, it outlines how the particular affordances drawn from participant thoughts and actions across Project TECHNOLOGIA can guide future investigation into the creation of a “time for telling” for promoting goal adoption, positive achievement outcomes, and transfer among students.

1. Conveying Context, Chronology, & Content

The story grammar inherent in narrative (i.e., beginning-middle-end structuring) allows story recipients to make inferences about context (e.g., cause-effect), chronology (e.g., before vs. after), and content (e.g., plot) even if they cannot perceive abstract meaning (e.g., theme, tone, morals). As noted by Young, Slota, Travis, and Choi (2014):

On its surface, the phrase [“The old man fell and broke his hip”] asserts that two individual events have occurred. However, many readers, drawing from their own experiences, assume a specific time sequence and causality, and conclude the fall broke the old man’s hip. In contrast—for an elderly man with osteoporosis—the hip fracture could have preceded and caused the fall. If we alter the statement to say, “He broke his hip and fell,” we recognize the occurrence of the same two events, but the word choice in the telling of this story may indicate to some readers an opposite time sequence and causality. This suggests that the interaction between the writer and reader includes non-explicit rules through which narrative structure serves as the keystone to understanding (pp. 3).
As long as the recipient is capable of understanding the producer’s vocabulary, grammatical organization within the given narrative is able to organize thinking and understanding without an explicit delineation of context, chronology, and content. Even the most simplistic narrative (e.g., “The old man fell and broke his hip”) affords the communication of “unspoken” elements, thereby transmitting information that could be critical for survival (e.g., warnings, food sources, mating calls). This is perhaps the single most important reason for narrative to have persisted across human evolution and natural selection.

Participant interactions throughout Project TECHNOLOGIA suggest that instructional utilization of the Context, Chronology, & Content affordance of narrative might be especially valuable for establishing perceptible cross-context invariance that can facilitate transfer. In the case of instantiating a new school district technology initiative, event sequencing and interaction—including visioning, explaining technology goals to others, determining which tools optimally fulfill the original vision, and dealing with issues associated with rollout—is critical to success (Slota, Young, & Travis, 2013). However, several learners entered the program with overly simplistic views on the relationship between visioning, tool selection, and communication among peers. Becky, Winnie, and Mandy, for example, began their participation already having specific technologies and other preconceived notions of what should happen in mind. This led them to somewhat naively work backward to identify philosophical foundations that would retroactively support their tool choices and/or rush to action without offering an underpinning philosophy whatsoever:

Becky (Thought Journal [TJ], Episode Number [1.2]): “The point for me is the device is just a device. When I text someone, I am using the phone to talk to a human. So any philosophy can happen with the use of the computer.”
Winnie (TJ 1.2): “I think it is interesting how much of these missions, or maybe just the beginning of the experience, is taken up by explaining our stance. It is funny though, because SOOOO much of education is talking about what could happen, and there is often a lack of action...Less talking, more testing out and taking action!”

Mandy (TJ 1.2): “As of now, I don’t see this story going in any direction. Perhaps that where a problem arises. Lots of talk....little action.”

Others, like Gretchen and Nadine, openly acknowledged their misunderstandings and confusion with how technology coordinators form and execute district initiatives:

Gretchen (TJ 1.2): “I have chosen a stance on the ultimate goal of the educational system (success in life via choice of careers) but I’m not sure that I have a clear stance of how to go about it.”

Nadine (TJ 1.2): “There are a lot of conflicting views on how education should be re-established.”

Nadine (TJ 1.3): “At times, the other operatives bring the discussion in so many different directions its hard to follow.”

Given that all participants were in-service educators who had experienced at least a small amount of ineffectual initiative enactment in their own districts, these statements would normally worry a program administrator. Yet, as the game progressed, interactions within the narrative environment provoked the identification of overlap between the game and their real world experiences. Many times, this came in the form of guidance from non-player character actions or statements:

Rheegan, irritated with the slow-going process, rolls her eyes and mutters loudly to herself:

“You people... A perfect opportunity to tell-off Duncan, but instead we're wasting our time fiddling with this junk and talking about individual skills. Ugh, what a waste.”

Biff stifles a laugh and walks away to make a call on his communicator. Duncan gives Will and Adan a warm smile before turning to Rheegan.

“Look, Rheegan, we knew from the get-go that this wasn't going to be a quick n' easy transition, so I can't help but wonder why you're huffing and puffing about the input these folks are offering. Frankly, I'm happy they've circled back to the situated
cognition thing Diego mentioned earlier--focusing on what people actually do and how we help them work toward those skills... sort of like Biff’s philosophy of education. Even you have to admit that they make a good point, the whole one-size-fits-all approach not being the be-all end-all of education.”

In response, Nadine first wrote:

Nadine (TJ 2.1): “… we’re finally getting to the “rebuilding phase” of the educational system…All avatars can identify their part in the process by relating it to their theory. It’s a good link between putting theory into practice.”

And later:

Nadine (TJ 2.3): “The crowd is getting very animated about changing the educational system. This is probably an accurate animation of how real people would act if there were BIG changes to the education field”

Winnie similarly expressed a change in attitude, attending to the potential problems associated with moving ahead if she and her peers failed to consider possible negative consequences:

Winnie (TJ 2.1): “This week’s prompt is all about a call to action. It seems like they are all eager to get going but Lienne took this opportunity to make sure everyone remembers that you cannot rush the choice of technology.”

The game’s story organization and context clues seem to have provided at least some of the information needed for learners to identify how and to what extent their particular attitudes, approaches, and behaviors would result in particular outcomes. The evolution of responses, too, highlights how participant thinking may have become better-rounded as a result of exposure to multiple non-player character perspectives (e.g., economic equalization, democratization, social competency). This is best captured in Winnie’s response during Week 15:

Winnie (TJ 3.3): “This week Biff asked the team to come up with the technology plan, but only offered really an outline for the mission. It is important for the team, in developing a proper technology plan to have a MUCH clearer understanding of the resources available, the cost and funding available as well. I set up the template for the team, and invited them all to join in and fill out our overall plan based off of the information provided. I also reached out to Biff and team welcoming them to share even more information. This can not be just a one sided planning, we all need to work together… Biff and team need to have a firm hand in this planning as well as the leaders (administrators) of this community.”
It seems reasonable to infer that the individuals who were most deeply engaged with the Project TECHNOLOGIA narrative developed insights that they did not appear to have at the start of their journey. Altogether, it lends credence to the notion that narrative has the potential to provide important information about Context, Chronology, & Content that puts key concepts (i.e., program learning objectives) at the forefront of student thinking and discourse.

2. Engaging & Motivating

Story producers often make specific linguistic choices they anticipate will resonate with as much of their target audience as possible. Whether or not those choices are well-planned might be how the audience distinguishes “bad” or “mediocre” story production from “great” story production within a specific genre, format, or field. This can be broadly referred to as narrative relatability, or the level at which a particular audience member will detect invariance between the given narrative and his or her experiences with the lived-in world. The effect is commonly observable in situations where the story recipient demonstrates parasocial interaction with a particular character (i.e., social surrogacy) but that character is unexpectedly and dramatically changed or killed as part of the plot—for example, Ned Stark’s execution in Martin’s (1996) A Game of Thrones or the death of Professor Dumbledore in Rowling’s (2005) Harry Potter and the Half-Blood Prince (see Cohen, 2004; Derrick, Gabriel, and Hugenberg, 2009).

Throughout Project TECHNOLOGIA, several participants commented on how non-player character dialogue shaped their on-going perceptions of right, wrong, and indifference within the game’s context, engagement with the story, and motivations for action. This included placation for the sake of avoiding conflict:

Tonya (TJ 2.1): “I am just trying to make “Duncan” or “Rheegan” happy at this point with any suggestion that I feel would work regardless of what a Behaviorist would say.”
Frustration:

*Becky (TJ 1.1):* “Already the other characters are getting on Diego’s nerves. “I won’t work with a gun pointed at me?” “What’s with the gun?” Stuttering? Really?”

Testing boundaries:

*Shawna (TJ 1.2):* “I have to say, while I am approaching the character much as I myself would speak (acting was never my thing) - I was sorely tempted to punch Bif in the face, just to see what would happen…”

Considering future action (e.g., planning, provocation):

*Becky (TJ 1.1):* “I decided to go with Duncan as my Ally, but with situated cognition Biff could be a good ally as well. As long as Diego clings to make it meaningful, full of experience...he should be fine.”

*Shawna (TJ 1.1):* “When the “administrators” get huffy, if you will, it’s easier to see where to go with my posting.”

*Becky (TJ 1.2):* “Rheeghen needs some calming down. I’m going to have to work with her. I once read a book (well skimmed it), called Even Mystics have Bills to Pay, I’ll work that in somehow.”

Amusement and/or intrigue:

*Dani (TJ 1.1):* “I bet this is fun for [our instructors] :) It seems like this could take lots of twists and turns.”

*Shawna (TJ 3.1):* “I feel like Rheegan is [our instructor] and [our instructor] is Rheegan. She is very fiesty and has started to curse, which is hilarious.”

And changes to personal philosophy and/or outlook:

*Winnie (TJ 1.1):* “I think my character is becoming enthralled with Biff’s vision for this world… I made it so that Lienne creates an Ally with this visionary character.”

*Becky (TJ 4.1):* My eight year old says that “Griefers” are meant to be blocked. I am taking the “I am being challenged to do better” with this.”

Though none of the characters in *Project TECHNOLOGIA*’s story experience the surprising or emotionally taxing outcomes of *Harry Potter*’s Dumbledore or *A Game of Thrones*’ Ned Stark,
these narrative-specific responses suggest that even relatively minor story elements are capable of triggering emotional connections between text and reader (e.g., characters, settings). This, in turn, can encourage reader investment and receptiveness to particular thoughts, messages, or ideas (e.g., Winnie and Biff, Becky and “griefers”). Instructors who use narrative in this way may be able to capitalize on emotional investment for the purpose of heightening engagement and inducing motivation to interact with particular ideas or themes embedded within the narrative—in the case of practomime, the course or program learning objectives.

3. Educating Intention & Attention

Whatever the benefits of engagement and motivation, emotional attachment alone is not enough to induce transfer. However, if applied toward tuning perception, it may be possible to shape intention and attention such that recipients will be able to recognize invariance between contexts, adopt new goals, and take action to achieve them (i.e., an intentional spring; see Shaw, Kadar, Sim, and Repperger, 1992). For instance, should a recipient form a parasocial relationship with a congenial and attractive, well-spoken and kind-hearted character, he or she will be more likely to attend to situations where the character perceives and acts in particular ways within the narrative context. This effect may be amplified via narrative formats that provide insight into how or why the character has adopted particular goals, attended to particular environmental elements, and made particular choices (i.e., first-person perspective). If an emotional bond is laid as a foundation for “telling,” a more knowledgeable other (e.g., classroom teacher) could discuss the nature of the beloved character’s thoughts, opinions, and actions such that the learners will be more likely to perceive similar opportunities for action across contexts.

This occurred at various points throughout Project TECHNOLOGIA, with some goal adoption events unfolding within the context of the story and others within the real world.
Interestingly, both within- and outside-narrative intentions emerged in response to particular non-player character statements or actions, often to counteract what a non-player character was attempting to do. Players would occasionally assert majority agreement to convince others to adopt similar intentions, though many goals emerged with a highly self-oriented rationale. Midway through implementation, Kelly noted that:

Kelly (TJ 2.2): “we seem to each be spouting our own agendas, but now it is time to begin conversing and coming to a consensus.”

Peer nudging in that direction prompted players like Winnie and Bella to develop new intentions built around personal responsibility and clarity:

Winnie (TJ 3.1): “This week I tried to outline a step-by-step plan for that the team. Not contributing last week, I felt the need to pull my weight and also provide a vision.”

Bella (TJ 2.1): “Still not comfortable with how I am going to incorporate my worldview into this prompt. Will work on a response in the coming days.”

Other interactions between players and non-player characters prompted reflection that led to new goals external to the game environment altogether:

Dani (TJ 1.1): “This seems like it would be awesome to do with my 5th graders in Social Studies around the American Revolution. They could take on roles such as the King of England, Patriots, Loyalists, tax collectors, British citizens, etc. I may try this in the Spring with my class. I think they would love it.”

Becky (TJ 2.2): “I have decided that with one class I am going to give them an assignment a day that in some way involves their cell phones.”

If, as suggested here, the narrative can help learners perceive invariance between in-game and external experiences, it may be possible to seed up-to-date technological, pedagogical, and theoretical information into live classrooms by way of story-driven games—something viewed as quite difficult within professional development and pre-service teacher education circles (e.g., Bobrowsky, Marx, and Fishman, 2001; Lawless and Pellegrino, 2007; Penuel, Fishman,
Yamaguchi, and Gallagher, 2007; Slota, Young, Choi, and Lai, 2014). This will require more extensive empirical study but has promise for being an alternative approach to more traditional pre- and in-service teacher workshops and coursework (Fishman, et al., 2003).

4. Creating Opportunities for Co-Action

Because narrative is the result of producer-recipient interaction, it affords an ever-present opportunity for writers and readers, designers and players to co-act. Among contexts like books and games, stories never exist solely in one individual’s mind—they are driven by multiple people with varying experiences, perceptions, and intentions (Young, Slota, Travis, & Choi, 2014; see Narrative Co-Construction). The production of any given narrative represents the merger of the producer’s life-world with his or her perceptions of external environmental forces, and the reception of any given narrative represents the merger of the recipient’s life-world with the producer’s story.

Participants in Project TECHNOLOGIA frequently commented that emergent opportunities for narrative co-action were crucial to participation, growth, and success throughout the program. Mandy regularly referenced collaborative problem solving in her thought journal entries:

Mandy (TJ 1.1): “I find that I’m referring to the other agents to help me formulate my thoughts.”

Mandy (TJ 3.1): “OK, a plan has been put forth and some actual progress can be made, but much will be left to Mission Control by way of data that can be provided to advance the story.”

Mandy (TJ 3.2): “We need to bring a united front, but I will have to see if anyone else participates before passing final words to the crowd.”

Mandy (TJ 3.3): “I began the presentation of a plan, and hope that my set up can encourage the rest of the group to chime in.”
This attitude was largely reflected in the way she responded to non-player characters and her peers throughout the narrative. For example:

*Mandy (Project TECHNOLOGIA [PT] Episode Number [3.3]):* With all that has transpired he can’t quite understand how individual agendas keep creeping back into the forefront of what should be a collaborative effort. “Diego, I applaud your ability to bring us all back to a point of conversation. If we keep going at each other in this regard, nothing will be accomplished. You’ve outlined some great starting points. One key aspect we also need to consider is - how as a new community will we work to develop an education system that reflects our new goals and manner of living.” With that last note, Will is willing to step up and begin to outline the new social order of this world. He asks for a volunteer with some political and unbiased connections to help him. As he’s new to the Remmlar Array he will need help navigating the waters of this quite different society.

“Perhaps recommendations can be drawn with this new knowledge from everyone. We must learn from history that personal agendas must be put aside in order to come to a consensus. We must be willing to sit and listen and learn from one another. Perhaps when no one is happy, when we all have pieces that can come together will we see the beginnings of a new educational system that works. We mustn’t be so quick to toe off, but rather to sit back and listen and maybe think and reflect on how we can marry all our ideas.”

Other participants, including Greg, Gretchen, and Winnie, highlighted specific co-active observations and/or behaviors as valuable to their respective gaming experiences:

*Greg (TJ 0.0):* “working and talking with the other avatars as a group help me understand not only the story but the way of game play, and of course provide me with the high level of fidelity that I’m really existing in that world and working with them..”

*Gretchen (TJ 1.1):* “I haven’t decided the best course of action yet, so I’m going to see how another team member responds first.”

*Gretchen (TJ 3.1):* “I think that I will continue to engage others, rather than just posting what I think or agreeing/disagreeing with the other posts.”

*Winnie (TJ 3.2):* “Gretchen did a great job stepping in and initially organizing the chaos in a way that I envision her controlling her elementary classroom (sometimes you need to really treat adults like kids).”

These statements emphasize the perceived importance of collaborative action within the narrative for reflection, memorability, and the creation of a “time for telling.” They also serve as a
foundation for facilitating metacognitive reflection on how and why particular actions unfolded in response to story elements as well as which technology coordinator actions are most closely associated with success and failure in real world K-12 environments. While the instructional leaders (i.e., producers) may have posted a particular prompt with a specific goal in mind, the students (i.e., recipients) clearly co-acted to attribute meaning, define emergent properties of the story, and interpret how to act on those properties given varying understandings about foundational narrative elements (e.g., characters, plot, theme, tone). Producer-driven storytelling is one way to encourage abstract critical thinking (i.e., Narrative: Level 1), but, as demonstrated in Project TECHNOLOGIA, it can also manifest as alternative visioning (e.g., providing new insights into the original narrative) or the presentation of alternative points of view among players (i.e., Narrative: Levels 2 and 3).

It is worth noting that peer-to-peer modeling likely fits under the same umbrella as co-action. While non-player characters seldom had an obvious impact on Project TECHNOLOGIA participants—save for a few outbursts of frustration over stubbornness—responses by some players appear to have affected the way in which others understood, interpreted, and interacted with the narrative. Those with minimal in-game participation were still capable of reading what others were doing (i.e., lurking) and provided an authentic audience outside of each team’s instructional leader. Additionally, the most active students could highlight their thought processes knowing that others might identify and adopt similar attitudes along the way (see Preece, Nonnecke, and Andrews, 2004; Yeow, Johnson, and Faraj, 2006). Given that roleplaying can convey information about what may or may not happen as a result of particular actions in particular contexts (e.g., parables, fables) (see Amorim, 2003), lurking could provide even non-active learners with information about the narrative environment or real world that they could not or
chose not to experience first-hand. Though this relies on a number of factors, including recipient attention, ability to reproduce the behavior, and motivation, the interaction between narrative, context, and recipient could have fostered vicarious reinforcement and the development of a legitimate peripheral learning environment (e.g., Lave and Wenger, 1991).

5. Nurturing Creativity

Creativity literature frequently describes two major components of creativity: novelty and task appropriateness (Guilford, 1950; Kaufman & Beghetto, 2009). The Four-C Model, in particular, explains how and why these components intersect to produce what are commonly considered “creative acts” (see Beghetto and Kaufman, 2007; Kaufman, Kaufman, and Plucker, 2009; Kaufman and Beghetto, 2013). Narrative producers engaged in the creative process (e.g., writers, game designers) rely on novelty and task appropriateness while generating stories intended to reach particular audiences. Though the vast majority of productions never approach Pro-C or Big-C creativity (i.e., professional and internationally validated creation, respectively), the intersection of novelty and task appropriateness represents the utilization of narrative for the purpose of demonstrating a particular idea or set of ideas. Put another way, their creative acts are the result of individual producers detecting invariants that were present for others to see but, on this occasion, were viewed through the lens of particular goals and experiences that resulted in unique action.

Narrative production organizes thinking and behavior for—at the very least—mini-c and little-c creative acts and is one of the primary reasons narrative has persisted so long across evolutionary history. It has enabled humans to elaborate on particular thoughts and ideas such that others can understand complex and abstract concepts (i.e., teaching). In Project TECHNOLOGIA, mini-c and little-c creative acts regularly emerged as part of the co-active writing process. This
included the introduction of novel, external goals (see *Educating Intention and Attention*) as well as references to external, trans-media narratives:

*Becky (TJ 1.1)*: “Rheegan (Exorcist) equal playing field- opportunity for everyone; Biff (really? Back to the Future)-critical thinking, Quality of life, big picture, where are we going; Duncan (MacBeth)-functional democracy, debate, collaborate, work together for greater good not just your own personal interests but what works for everyone.”

*Becky (TJ 2.1)*: “not for nothing did Diego watch all the new Episodes of Battlestar Galactica, although he much preferred Caprica. In the 70s, he actually watched the original show.”

*Becky (TJ 2.2)*: “This is like the movie contact. I asked to see all the cool different people and aliens, and I’m on a beach with my dad. Instead of being on the beach I’m in a computer lab looking at iPads.”

*Walter (TJ 1.1)*: “Project Technologia has some analogies to ‘The Matrix” (movie). I love the Matrix!”

Furthermore, some participants actively sought opportunities to discuss the realities of encouraging change in a deeply resistant educational system:

*Becky (TJ 2.3)*: “I’m having a very hard time with Rheegan’s hostility. I know that my district is very technology oriented and they are encouraging the BYOD and wifi policy.”

*Winnie (TJ 3.1)*: “I do think though that these episodes make sense but in the world of hypothetical, it is hard to REALLY suggest things in the way you would as a true ed tech specialist in todays world.”

*Nadine (TJ 3.2)*: “The crowd is getting very animated about changing the educational system. This is probably an accurate animation of how real people would act if there were BIG changes to the education field”

Imaginative, cross-context thinking could play a major role in limiting the perpetuation of test-oriented traditional direct instruction and lecture (e.g., Fleer and Peers, 2012). As highlighted above, *Project TECHNOLOGIA* participants demonstrated content mastery by identifying and associating orthogonal concepts (e.g., film, personal stories) with what they experienced in-game. Utilized in conjunction with well-devised instructional guidance, this could lead to whole-group
analysis of discrete social and cultural barriers associated with the planning of new educational technology initiatives. Direct instruction from a skilled teacher educator or administrator could theoretically draw attention to the same basic concepts, but co-action surrounding a shared, co-developed narrative appears to lay a fertile grounding for student exploration, debate, and creativity over and above content—an extension of improved student agency and ownership over their learning. This is a very different framework from the “gamification” approach of implementing simplified behavioral approaches to learning as games in the classroom. As a result, it seems feasible that the development of better and more effective stories may significantly move learning scientists toward a deeper understanding of how particular types of narratives interact with particular students and instructional settings to yield optimal learning outcomes.

**Limits of Interpretation**

As with any study of human thinking and behavior, data collection and analysis throughout Project TECHNOLOGIA was subject to bias in individual participant and investigator intentions, preconceptions, and interpretations. In their review of why novel approaches to technology implementation fail, Slota, Young, and Travis (2013) affirmed that education research is often plagued with “situations where participating educators “do it for the researcher(s)” or for the status of being part of the research team, or the resources involved in a grant project” (pp. 42). Given the nature of the Master’s program from which participants were drawn, it is possible that some could have misrepresented their own judgments, ideas, or comments believing that they would help or earn favor with the investigator or program administrators. Likewise, if a particular participant or group of participants had some intention to willfully misinform the investigator or otherwise hurt the project, they could have entirely misstated their thoughts within the “Operative Thought Journal.”
It is equally plausible that the concepts, feelings, and thoughts associated with play were simply too complicated to be accurately captured in self-reported text. While Norris (1997) argued that this does not inherently invalidate qualitative research, it does pose an on-going problem for researchers seeking to equate ethnographies, grounded theory studies, or other qualitative work with more traditional quantitative approaches. At issue is the fact that humans are multifaceted, possessing attitudes and behaviors that change moment-to-moment as a function of environmental context, prior experience, and emerging goals. Ideally, triangulation with participants, peer review, and repeat study can minimize bias, but until statistical models and technologies offer greater specificity than the standard normal curve, granular assessment of participant thought and action will be limited to qualitative investigation at the individual level.

To minimize bias, the investigator refrained from teaching or grading participants throughout the game-based program’s duration (i.e., the period during which the game/program primarily took place), and participants were not required to contribute to the game as part of their courses or Master’s program plan of study. They received a face-to-face debriefing session as part of their final week of the Master’s educational technology program, and at that point, the investigator listened and responded to questions, concerns, and feedback that could inform the analytical process. Additionally, the investigator conducted member checking (e.g., sharing findings, asking for participant feedback) to ensure that the analysis accurately reflected their individual intentions, goals, and understandings of what was written and transpired within each team. The open and axial coding process was conducted under the advisement of a second researcher and verified through a combination of re-coding and peer debriefing once the initial nodes were deconstructed for the purposes of cataloguing thematic outcomes across the data.
Due to limited sample size (n=14), unequal distribution of participant sex, non-random sampling, and the qualitative approach to data collection and analysis, the findings from this study only reflect the knowledge, attitudes, and behaviors of those who chose to participate. The results are not generalizable to a larger population and should not be used to draw conclusions about Master’s educational technology programs, graduate students, or learners as a whole. However, the study does provide a potential starting point for future research into narrative affordances for education, the organization of narrative across content areas, and the details of game-player-context interaction. Should this occur, it will be important to establish the individual differences between the participants featured in this study and those of any subsequent research.

Conclusions

Bruner (2004) reasoned that humans evolved to understand their lives in terms of narrative structure, suggesting that “...a life as led is inseparable from a life as told—or more bluntly a life is not ‘how it was’ but how it was interpreted and reinterpreted, told and retold” (pp. 708). Indeed, stories are the preservation and expression of humanity, a mirror through which individuals gaze upon their histories and generate personal truth. However, identifying precisely how narrative intertwines with the lived-in world requires the application of a situated cognition framework to understand recipient-content-context interactions as dynamic and co-determined.

*Project TECHNOLOGIA*, used to begin unpacking this issue, emphasized in-context, on-the-fly dialogic interactions between “producers” (i.e., instructors) and “recipients” (i.e., participating students). Results indicate that there may be value in pursuing a narrative approach to complex social, cultural, and intellectual issues such as coordinating administrative initiatives within a K-12 school district. Specifically, there appeared to be five emergent affordances of narrative for *Project TECHNOLOGIA* participants (i.e., Conveying Context, Chronology, and
Content; Engaging and Motivating; Educating Intention and Attention; Creating Opportunities for Co-Action; Nurturing Creativity), and each affordance seemed to intersect with the others to heighten learner perception, goal adoption, and transfer. These affordances could serve as a cornerstone for constructing optimal generator sets that advance pedagogy, revise pre- and in-service teacher professional training, and improve the current approach to game-based instruction.

This study is a first step toward resolving the two questions posed at the beginning of this piece (i.e., “How can narrative be optimally characterized within the field of educational psychology?” and “What are the specific affordances of storytelling and narrative structure for learning?”) as well as Young et al.’s (2012) goal of identifying how and why particular players interact with particular games in particular ways under particular conditions. Further investigations should target the ways in which varied narrative formats (e.g., script, novel, game) influence motivation and achievement in addition to how particular storytelling mechanics (e.g., tone, character development) individually and collectively convey content, improve engagement, and promote goal adoption. Like any capable protagonist, we must act promptly but with enough caution to ensure we do not dismiss the castle of our betrothed in favor of another that merely plays host to a hostile dragon. That is the only path to conquering the field of game-based learning and, of course, living happily ever after.
References


CHAPTER II

Project TECHNOLOGIA:
A Game-Based Approach to Understanding Situated Learning

Abstract: By better understanding the way game mechanics influence student learning, the educational community may begin to isolate the useful elements of game-based coursework that expand ideas of so-called “gamification.” However, this is predicated on the research community’s understanding of complex player-game-context factors such as transfer, interaction, and intentionality. In pursuit of that goal, qualitative data was used to define transfer, interaction, and intentionality in a dual text-based alternate reality/roleplaying game, Project TECHNOLOGIA. Findings suggest that the biggest contributors to meaningful game-based learning may be student-perceived agency within the associated narrative, interactions with non-player characters (i.e., the game’s story), and guided inquiry. This implies that the way instructors and players co-construct the narrative may be at least as important to a game’s educational utility as the game’s other mechanics. Recommendations for further research and development are provided.

The notion that games might be used to enhance learning is nearly as old as the concept of formal education itself. Plato posited in The Republic that crossing the barrier between reality and pretend is tantamount to understanding how learning can and should be accomplished (Travis, 2011). This idea has persisted through contemporary cognitive science, including Dewey (1938), Bruner (1961, 1966), Vygotsky (1978), and Gee (2003), arriving at a critical turning point where virtual reality can now simulate real-world activities so closely that learners can inquire, explore, and interact with artificial environments in ways that directly mirror real world experiences. Several studies have emphasized gaming’s potential for improving academic performance (e.g., New Media Consortium, 2014; Tobias and Fletcher, 2011; Wouters, van Nimwegen, van Oostendorp, and van der Spek, 2013; Young et al., 2012), and though more work is needed to optimally employ the potential affordances of educational gaming, there is an increasingly pervasive belief that game-based learning can change the way instructors and students interact with academic content (Johnson, Levine, Smith, & Stone, 2010; Johnson, Smith, Willis, Levine, & Haywood, 2011; New Media Consortium, 2014).
However, there are still multiple hurdles to the integration of content, pedagogy, contemporary learning theory, and games for education (e.g., Slota, Young, and Travis, 2013; Slota, Young, Choi, and Lai, 2014). Businesses, universities, political leaders, and parents often have disparate expectations for what K-12 graduates can and should be able to accomplish regardless of how pedagogy and assessment have—or more accurately, have not—changed since the 1970s (Cronbach, 1975; Deville & Chalhoub-Deville, 2011; Haney, 1981). Additionally, video games have spent three decades under intense scrutiny over their perceived potential to desensitize children to violence (e.g., Gentile, 2010; Gentile, Lynch, Linder, and Walsh, 2004), induce addiction (e.g., Turner, 2008), and diminish physical health (e.g., Wack and Tantleff, 2009; Williams, 2007). While some games have been touted as exemplars of what game-based learning can offer educators, they often fail to incorporate the skills necessary for 21st century careers and build on the flawed assumption that far transfer will happen simply as a byproduct of play (e.g., Detterman and Sternberg, 1993; Gick and Holyoak, 1980; Slota, Young, and Travis, 2013). This includes both antiquated educational games (e.g., *Math Blaster, Oregon Trail, Where in the World is Carmen San Diego?*) as well as newer games and game-like programs (e.g., *Math vs Zombies, Classcraft*) that encourage students to solve math, history, and language problems by completing thinly-veiled educational tasks amounting to little more than multiple choice tests coupled with operant conditioning.

For example, Ke’s (2007, 2008) implementation of a specific *Math Blaster*-like game called *ASTRA EAGLE* indicated:

Most participants lacked a reflection process for performance analysis, new knowledge generation, evaluation, and integration…when facing a poor game design where the learning activities were not deftly veiled within the game world, participants reacted by deeming learning as a foe and chose to simply bypass it (2008, pp. 1614-1615).
Young et al. (2012) further highlighted this issue in their analysis of 363 game-based learning research articles. Despite their attempt to identify correlations between games and achievement, they found that continued searches for subjective and vague outcomes (e.g., fun, achievement) ignored the underlying game mechanics that stimulate student reflection, motivation, and self-efficacy and likely distracted researchers from what might be more valuable lines of inquiry:

What may seem like missing information may in fact point to a misdirection in our original question: Do video games enhance academic achievement? Our first recommendation calling for a shared working definition suggests that video games vary widely in their design and related educational affordances: Some have elaborate and engaging backstories, some require problem solving to complete 5 to 40 multiplayer quests, and some rely heavily on fine motor controller skills. With this range of attributes, perhaps no single experimental manipulation (independent variable) can ever be defined to encompass the concept of video games writ large. Furthermore, given the diversity of student learning goals and abilities, likewise perhaps no singular outcome (dependent variable) from video games should be anticipated.

Instead, applying principles from situated cognition suggests that research should focus on the complex interaction of player–game–context and ask the question, “How does a particular video game being used by a particular student in the context of a particular course curriculum affect the learning process as well as the products of school (such as test grades, course selection, retention, and interest)?” No research of this type was identified in our review, suggesting the missing element may be a more sophisticated approach to understanding learning and game play in the rich contexts of home and school learning (Young et al., 2012, pp. 84)

Given these and other, similar outcomes, current approaches to game-based education appear to neglect the affordances for goal adoption, resilience, and motivation that make games a compelling area of study in the first place. Rather than continuing this misdirected line of research, educational game designers and investigators may benefit from more closely considering how particular game mechanics interact with particular player (i.e., learner) intentions in particular contexts: a situated approach.

This study aims to bridge the gap between extant game-based learning literature and the situated worldview of human thinking and learning. It explores the effects of a game built to
facilitate educator visioning, technology integration, and collaborative problem solving in service to answering the following three questions:

1. How can a game-based program influence learner/player application of domain knowledge in the form of demonstrating a desired skill (e.g., using educational technology content knowledge to fulfill the responsibilities of a school district technology leader)?

2. What interactions occur between players, the instructionally-relevant game, and the instructional context?

3. How can a game-based program be used to induce individual intentions for learning more about both the game and related domain knowledge (e.g., educational technology visioning)?

An ecological approach may provide an optimal foundation for studying the granular player perceptions and interactions needed to make educational games more effective. This could eventually lead to better design for shaping understanding, goal adoption, and transfer across a variety of domains. Recommendations for further development follow.

*Gaming in Education*

Research on educational games is an emergent field with a very brief history. The *Journal of Game Studies* began publication in only 2001, and it was not until 2011 that Honey and Hilton described several affordances of game-based learning for the purposes of advising the Committee on Science Learning: Computer Games, Simulations, and Education. Their work revealed that while science simulations were a promising means of introducing students to the sciences, research on games as a whole could only be categorized as “inconclusive.” This finding has been repeatedly reinforced in analyses like Young et al.’s (2012) meta-review on trends in game-based learning, Wouters, van Nimwegen, van Oostendorp, and van der Spek’s (2013) meta-analysis of motivation, engagement, and achievement in educational game environments, and Tobias and Fletcher’s (2011) broader study of games for learning.
To date, most research examining educational game effectiveness has been organized around single experiments featuring games that have not been made publically available for further exploration (Young et al., 2012). Though there are some instances where games have been used to examine shifts in student behavior and domain knowledge (e.g., ASTRA EAGLE, Citizen Science, iCivics), many have been hampered by small sample sizes, non-statistically significant results, and modest power (Annetta, Minogue, Holmes, & Cheng, 2009; Clark, Nelson, Chang, Martinez-Garza, Slack, & D’Angelo, 2011; Kennedy-Clark, 2011; Sanchez & Olivares, 2011; Wrzesien & Alcañiz Raya, 2010). The most widely studied game, Quest Atlantis, is one of few that is both widely available and correlated with positive academic achievement, but its analysis has not addressed how and why players do or do not engage with academic content as designers intend (Anderson, 2008; Arici, 2009; Barab, Goldstone, & Zuiker, 2009; Zuiker, 2008). Virtually no studies have examined the relationship between player goal adoption and in situ behavior (i.e., how and whether or not players adopt and execute actions to achieve non-prescribed goals for play) which has made it difficult to predict whether or not a particular game is capable of achieving what its designers hope (Slota, Young, & Travis, 2013; Young et al., 2012).

The dearth of research in this area has highlighted the importance of pursuing data at the individual student level: it can help educational psychologists catalog how particular game mechanics, narrative elements, and interactive environments transfer to real world environments, and it can be used to shape the particular goals and behaviors of particular individuals in particular learning environments. Additionally, it can inform the design of optimal generator sets for specific, process-oriented environmental interactions intended to improve game-based learning effectiveness and promote goal adoption among student users (Young et al., 2012). However, given the highly complex nature of K-12 learning environments, research targeted at large groups
of individuals extends beyond the realm of traditional, linear statistics. This requires a targeted approach primarily driven by student-student, teacher-student, and student-environment interactions.

**Addressing Instruction with Situated Cognition**

Even with recent changes to the American education system, including enhanced 21st century learning objectives (e.g., Common Core State Standards Initiative) and improved measures of large scale student assessment (e.g., Smarter Balanced Assessment Consortium), introducing new classroom pedagogy is no easy task. Contemporary instructional methods are frequently touted as unifying the world of school with the world outside of school (e.g., using games to induce transfer) despite evidence to the contrary. As noted in the introduction, transfer is both rare and difficult to measure predominantly because it relies upon an individual’s ability to recognize variant and invariant elements of a given environment under highly dynamic conditions (Bransford, Brown, & Cocking, 2000; Gick & Holyoak, 1980; Young, 2004). Tuning students’ perception to achieve this end relies upon experience with the lived-in world, and many pedagogical tools fail to provide either the hands-on exposure necessary to make invariance apparent or provide the soft scaffolding (Brush & Saye, 2002) of a more knowledgeable other who can guide learning. This means that in order to stand out from other instructional practices, game-based learning environments need to be authentic enough to promote student recognition of invariance and possibly provide opportunities for personal and social reflection (Schwartz & Bransford, 1998).

A core premise of situated cognition is that interactions between an individual and the environment are the basis for knowing about and acting in the world (Figure 1). Put another way, knowing is an active process rather than a solid block of facts, memories, and other internalized,
non-measurable entities (Brown, Collins, & Duguid, 1989). Because activity, context, and individual life-worlds (Barab & Roth, 2006) are so important to developing understanding, direct instruction in classrooms and other relatively impoverished approaches to teaching often fail to present knowing as an active process in the same way that simply reading about car repair does not qualify an individual to fix a car.

![Figure 1. The perception-action loop associated with a situated worldview.](image)

To effectively utilize games for educational purposes, teachers, researchers, and administrators must re-examine the overarching purpose of education. Creativity, problem solving, and critical thinking all require deep, rich interactions with the environment in order to be enacted by a knowledgeable doer (Abe, 2010; Young, Slota, Travis, & Choi, 2014). Narrow, direct instruction-focused curricula “take account of only the choice of answer and not of the quality of thought that led to the choice” (Hoffman, 1965, pp. 150)—a fundamental issue when problem solving is the target learning objective. While computer adaptive testing and Item Response Theory have expanded psychometricians’ abilities to address this problem, it remains difficult to appropriately measure actions and behaviors if the student is not asked to do something that reflects a desired domain skill as it would be done in a realistic context. This is especially true in mathematics and the sciences where problem solving involves hypothesis formation around an authentic problem, followed by experimentation, data collection, and interpretation of often multi-faceted results. Yet, the same argument could be made for the social sciences and language
learning where the social-environmental context dominates an individual’s understanding of cultural norms, behavioral interpretation, and the development of language skills in the context of second language fluency as a negotiation for meaning (Gee, 2010; Zheng, Young, Wagner, & Brewer, 2009).

Of course, there are practical reasons why the active, problem-based learning associated with situated cognition is not as widely favored as alternative instructional methods (e.g., direct instruction): 1) it often requires much more time and greater resources than do traditional forms of instruction; 2) it assumes that the desired authentic practice can be simulated in the K-12 environment; and 3) it undermines the long-term belief that learning occurs according to presumptions about information processing (Tylee, 1997). Furthermore, the high stakes tests associated with the No Child Left Behind (NCLB) Act and Common Core State Standards (e.g., Smarter Balanced) are statistically reliable and valid for the purposes of identifying broad achievement within a school system and largely predict student performance—something that open-ended, longitudinal problem-based assessments generally cannot do (Hickey & Pellegrino, 2005). However, because experiential assessments serve to make instruction more student-centered and offer learners the opportunity to receive hands-on, practical experience (e.g., Kilpatrick, 1918; Dewey, 1938), both the instructional and assessment processes associated with problem-based learning tend to result in students who are better prepared to face complex problem-solving than those who have been trained under a direct instruction model (Boud, 1985; Cognition and Technology Group at Vanderbilt [CTGV], 1990; 1993; 1994; Papert, 1980). If learning, instruction, and the assessment process are indeed intended to produce a citizenry capable of such application, problem solving, and collaboration skills, problem-based, experiential activities like those found in games are a logical candidate to replace or supplement standardized summative
testing with immediate (i.e., observation) and close (i.e., artifact production) assessments (Hickey & Pellegrino, 2005; Hmelo-Silver, 2004).

**A Focus on Intentionality**

Part of the problem with simply adding educational games to existing curricula is that doing so treats their use as an intervention rather than a complex interaction between various elements of the *in situ* classroom environment. Successful classroom implementation of a particular technology, pedagogy, content area, or learning theory cannot occur in a vacuum (Koehler & Mishra, 2009; Slota, Young, Choi, & Lai, 2014). Failing to simultaneously account for all four instructional elements omits critical information about learner goal adoption, prior experience, and the process by which players decide to take particular actions within a game. Data analysis that misses this point is thereby limited to non-specific judgments about player behavior rather than a rich description of game-player-environment interfacing. However, there are three factors whose deeper consideration may help steer game-based learning research away from this trap: transfer, interaction, and intentionality.

Studies of *transfer* can provide feedback about the real world application of knowledge, attitudes, and behaviors learned through gameplay (Travis, Slota, & Young, 2013). While a student might be able to repeatedly demonstrate a skill in class after playing an educational game, this does not necessarily imply she will be able to demonstrate that skill elsewhere (Gick & Holyoak, 1980; Young et al., 2012). Knowing if a particular game facilitates the perception of invariance between game and external experiences could have important consequences for educational game development and implementation. For example, if particular game mechanics have affordances for inducing real world goal adoption, they may be helpful for educators seeking to improve student self-study, inquiry, or other life-long learning skills.
Whether or not this is likely to occur can be revealed by examining interaction, the emergent, particular interchanges between games and players. Interaction research emphasizes the ways in which individuals learn from and adapt to play (Young et al., 2012). When educational games are studied in the context of schools or classroom environments, data collection is generally limited to the parameters of the experiment-as-designed, and data falling outside the immediate realm of the dependent variable(s) are often lost or overlooked. Yet, if knowledge is rooted in particular, individual interactions with the world, the act of removing information based on those interactions—even if they appear unrelated to the target variable—may mask how and why individuals choose to play at all. One student might play a city-planning game as the designer intended (e.g., “build the biggest city”), but the game mechanics may afford alternative approaches to play (e.g., “drown the population in a nearby river”). If a second student perceives and wants to act on the drowning affordance, he may spend the class period submerging his townspeople in the water. His interaction with the game is no less valid than working toward the desired learning objective, but if the student who drowns his population has his interactions omitted as part of data analysis, the investigator will miss what may be a much more instructionally useful dataset.

This leads to intentionality—the organization of a particular player’s individualized goals (Gibson, 1986; Kugler et al., 1991; Shaw et al., 1997; Young, Slota, Travis, & Choi, 2014). When designers build a game, they make certain assumptions about the ways in which a player can and will interact with the virtual environment. However, despite the fact that intention can be shaped or induced through play (see Shaw, Kadar, Sim, and Repperger, 1992), there is no guarantee that a player will automatically adopt the designers’ desired objectives. In the city-planning game mentioned above, the player who drowns his townspeople perceives and acts upon affordances within the game framework that run orthogonal to the designers’ goal. Without understanding how
and why players behave this way, game developers and researchers can only guess about the thinking and learning that support game-player-context interaction. Though some of those guesses may ultimately be correct, there is no reason to expect any accuracy if there is limited or no qualitative triangulation with the thoughts, feelings, and goals of the people interacting with the game and the environment in which it is used. One proposed solution might include collecting and analyzing log file data, but even this approach has complications—for instance, if a student playing the city-planning game takes no action for three minutes, his motives do not necessarily involve reading on-screen text. They could instead represent confusion, tabbing into another window, or leaving the computer altogether (e.g., using the restroom). As a result, researchers should approach traditional, quantitative inquiry with an eye to qualitative measures that can inform how and why thinking and learning unfold during play. Failing to do so will only perpetuate the issues outlined above (e.g., Ke, 2007; 2008; Young et al., 2012).

Summary

Direct instruction and other traditional educational models perpetuate a separation between learning and the situations to which it is and can be transferred and applied (Everson, 2011). Conversely, game-based instructional environments have the potential to provide contextually-rich anchors for domain knowledge and skill development. Such anchors can be tailored to support continuous, embedded formative assessment systems that allow players to learn and act in-context (see CTGV, 1990; 1993; 1994), supplementing the distal and proximal measurement offered by direct instruction and high stakes testing (Hickey & Pellegrino, 2005). This inherently supports reflection as related to lesson, unit, and course objectives while directly or nearly directly mirroring reality. As a result, games should be considered an appealing option for the development and implementation of new forms of pedagogy capable of measuring student learning and contextual
knowledge in depth. Educational researchers may be able to further reinforce this approach with a deeper exploration of transfer, interaction, and intentionality as they relate to play.

Project TECHNOLOGIA

Toward the goal of improving in-service teacher education and better understanding issues of transfer, interaction, and intentionality in game-based learning environments, the staff of a large, public university Educational Technology graduate program chose to develop a dual alternate reality game (ARG)-roleplaying game (RPG) named Project TECHNOLOGIA. Its plot follows the administrators of a fictional space vessel, Remmlar Array, headed by Duncan Matthau and his assistants, Rheegan Hamilton and Biff Wallace (Appendix A). Over the course of six episodes (i.e., content modules), students are asked to envision, design, and stabilize a new educational system by providing guidance to the space station leaders. This makes the end task—balancing the needs and desires of a K-12 school district—the same from both narrative and academic perspectives.

Importantly, the story underlying Project TECHNOLOGIA’s pairs its embedded game objectives with the learning standards of the NETS-C (International Society for Technology in Education [ISTE] standards for technology coaches; see ISTE, 2014) at a 1:1 ratio, transforming the traditional teacher-centered learning environment into a student-centered learning environment where participants work in research groups, co-construct solutions to complex social problems, and directly perform tasks typically assigned to practicing educational technologists (i.e., a form of anchored problem-based learning). It also encourages cooperative effort toward resolving richly authentic problems, thus promoting the application of skills necessary to successfully, efficiently, and wisely integrate technology within the K-12 classroom.
While it is not a video game, per se, *Project TECHNOLOGIA* acts as an online text adventure set within the Blackboard™ Learning Management System. The alternate-reality narrative is used to frame student activities in the broader Master’s degree program while the roleplaying narrative guides online interactions with non-player characters that introduce a host of realistic challenges to the graduate student operatives. The design decision to avoid a strictly digital world was made for two reasons: 1) based on existing literature (e.g., Wouters, van Nimwegen, van Oostendorp, and van der Spek, 2013; Young et al., 2012), fully virtual environments can be too confining to adequately fit the needs of a teacher/student and/or inhibit instructor/player creativity and agency; and 2) overly complex game mechanics and/or a high technological barrier to entry might discourage all but the most video game-savvy from positively participating.

Development began with the identification of relevant NETS-C objectives/standards followed by the determination of how story elements could unfold at a 1:1 ratio with those goals, reflective of the top-down instructional design approach associated with effective curriculum building (Bergmann & Sams, 2012). This placed emphasis on the game's ruleset (i.e., how play happens) in order to bring students closer to completing tasks that real world educational technologists strive to overcome: problem solving, critically thinking, examining existing literature, generating new questions, collaborating toward realistic shared goals (e.g., “develop a comprehensive technology plan that represents a unified vision for the district”). Additionally, because the narrative was built to follow the same trajectory as the state and national standards (i.e., NETS-C/ISTE), the missions could be transparently aligned with information the students would need to complete their program coursework and degree requirements. As a result, the narrative as currently devised is able to carry much of the weight usually attributed to direct instruction, allowing instructional leaders (i.e., the Master’s program administrators) to use the
exploratory prompts as an introduction to content application (i.e., scaffolding both successes and ‘productive failures’ in problem solving, critical thinking, etc.).

The game’s richness draws from social interactions that take place as a result of student participation in character teams. On a biweekly basis, each team enters the RPG through our web browser-based heads-up display (HUD) called the Texto-Spatio-Temporal Transmitter (i.e., TSTT; hosted via Blackboard™ discussion forums). The TSTT hosts the immersion sessions, all of which are connected to form a progressive, media-enhanced story. The operatives (i.e., educational technology Master’s program students) are encouraged to use external research, various scientific journals, and information taken from their coursework to synthesize the information they engage with across the duration of their Master’s program.

The “Project TECHNOLOGIA Prompt Trajectory” (Appendix B) highlights how the program objectives are represented by a series of narrative episodes, all of which have a “minus,” “neutral,” and “plus” modification. These designations lead to modified versions of the narrative depending on the players’ in-game actions (e.g., helping vs. attacking a non-player character). While groups can shift from one track to the next, they cannot shift across two tracks in one session. Importantly, the differences between the “minus,” “neutral,” and “plus” versions of the narrative are almost entirely cosmetic (e.g., characters responding with different facial features, slightly different phrasing of ideas) and are used to push the student operatives closer to the primary program objectives (i.e., “Visioning” as defined by the NETS-C/ISTE standards).

Assessment is continuous, embedded, and formative, based on a combination of in-game dialogue, player-player and player-instructor interactions, and journals maintained by each operative throughout implementation. After viewing an objective-based prompt posted in the TSTT by an instructional leader, the students collaborate with their teams to act within the
gamespace. This allows the instructors to evaluate collaboration and visioning (see NETS-C/ISTE standards) with emphasis on the complex challenges facing educational technology specialists. Additionally, it maintains focus on application by placing learners in complex, problem-rich contexts that require creativity, intellectual risk-taking, and self-evaluation of learning. Altogether, the process exemplifies the constructivist nature of the program by allowing students to piece together on-going portfolios that establish longitudinal, experiential growth over the breadth of the Master’s program, exhibiting the cumulative spiral effect described in Bruner’s (1966) four governing principles of constructivist instruction (Young et al., 2012).

**Investigative Methodology**

*Project TECHNOLOGIA* implementation began in February 2014 and ran for 24 weeks between the spring semester and early summer. Participants included 14 students (12 female, 2 male; 12 Caucasian, 2 Asian-American, 1 Hispanic) aged 22 to 65 years enrolled in a one-year, accelerated Educational Technology Master’s program at a large, public university. All were in-service educators at the time of participation, and their collective career backgrounds included elementary, secondary, and post-secondary experience in rural, urban, and suburban districts. Though small, the participant pool afforded direct supervision of player-game-context interactions and was readily accessible, straightforward to track, and represented the same individuals who would benefit from the outcomes of this type of research (namely educators) (Suter, 2012).

Participants were assigned to three teams—two groups of five and one of four—each guided by a separate instructional leader. The instructional leaders included two advanced doctoral candidates and one university faculty member, all three specializing in cognition, instruction, and learning technologies and thoroughly familiar with the goals and coursework of the Educational Technology Master’s degree program. Their responsibilities included posting new *Project*
TECHNOLOGIA episodes per the predetermined schedule, responding with non-player character actions and dialogue as needed, and keeping interactions and progression centered on the NETS-C and ISTE standards. Student participants, by contrast, were responsible for controlling separate player avatars/characters that could speak, “think” (i.e., give third-person descriptions of avatar thoughts), and act within the story framework. Additionally, all student participants were provided with private Operative Thought Journals to be used for describing personal thoughts and feelings, outside influences on participation, and goals across game implementation (Appendix C). Though the journal entries were not directly used to inform story development, responses in Blackboard™ (i.e., character behaviors as expressed in story posts) provided critical information for the instructional leaders to plan future in-game events (e.g., non-player character dialogue, activities). Learning objectives and in-game prompts were consistent across all participant groups, but text details (e.g., non-player character phrasing, diction choices) varied slightly based on particular team choices (e.g., attacking a non-player character vs. assisting a non-player character) and the discretion of the instructional leaders.

Qualitative Analysis

Despite the fact that game environments are situated much in the same way as other learning contexts, little is known about how and why particular games elicit particular play goals and actions among particular players (Young et al., 2012; Young, Slota, & Lai, 2012). As a result, the investigator elected to utilize grounded theory analysis in hopes of facilitating the development of new theories about agent-environment interaction in educational games (Glaser, 1992; 1998). The approach was set within an interpretation theory framework and designed to organize emergent player/student interactions throughout Project TECHNOLOGIA (Potter & Wetherell, 1987; Rennie, 2007; Thomas, 2003; Young et al., 2012). Furthermore, because the game
emphasized open, interpersonal dialogic loops between participants, the investigator attempted to collect, catalog, and analyze data without adversely altering the content’s original context (i.e., within a particular Operative Thought Journal or specific prompt thread) (Cheek, 2004). This would allow for the maintenance and evaluation of important cues, comments, and player-player feedback present within the original gamespace (e.g., ways to improve future performance, instances of real or perceived failure, points of critical thinking—any data that could be extrapolated into broader categories) (Bakhtin, 1981; Foster & Ohta, 2005). The Operative Thought Journals were primarily used to categorize individual differences in thinking and learning among participants, informing researcher interpretation of player perceptions, actions, and intentions emergent in player-player and player-instructor discussion post dialogue.

There is no singularly correct way to administer a grounded theory approach. However, several steps tend to be consistent across the studies in which it has been applied (e.g., Shaw and Bailey, 2009). These steps allow the researcher to make inferences about social interaction based on how statements are phrased, which words are most or least commonly utilized, and what responses particular statements or questions yield (Thompson, 1988). This is helpful in establishing how complex social behaviors such as group learning manifest in real world contexts (Berger & Luckman, 1967), especially given that meaning, symbols, knowledge, and other abstract concepts are socially constructed (Lave & Wenger, 1991; Vygotsky, 1978). To that end, the investigator made several assumptions prior to qualitative data analysis. Specifically: 1) interaction is favored over outcomes and products; 2) all data must be analyzed by an individual (i.e., the researcher) rather than a machine or piece of software; 3) subjects must be studied in-context, implying the need for triangulation (in this case, understanding student situations and the context for communication); 4) data analysis centers on interpretation and the emergence of meaning; 5)
there is inherent orientation toward constructing hypotheses, concepts, and theories from details rather than using details to confirm or deny existing hypotheses, concepts, or theories; 6) all interactions are formed as the result of dialogue and meaning will come as a result of player-player and player-instructor interaction (Bakhtin, 1981; Creswell, 1994; Hathaway, 1995; Merriam, 1988). This was intended to stress how and why participating students developed particular intentions, co-constructed particular types of solutions, and adopted particular strategies in Project TECHNOLOGIA, affording much richer interpretation than would have been possible with a quantitative evaluation of student progression toward a particular dependent variable (e.g., achievement, motivation).

Analysis took place as a nine-step process (Table 1) beginning with the import of all 274 Blackboard™ discussion posts (Table 2) and 14 Operative Thought Journals into QSR NVivo 10 (approximately 44,400 words excluding the pre-written, episodic narrative prompts). Given the contextual differences between the two (i.e., co-constructed in-game vs. individual/internal, respectively), the investigator approached them as separate entities to inductively pinpoint common word, phrase, and concept usages exclusive to each source (e.g., “collaboration,” “goal,” “I would like to…”). Due to the sheer volume of common word, phrase, and concept usages embedded in each participant contribution, the investigator further parsed each source into composite idea units comprised of individual comments, statements, and/or questions. These idea units were occasionally shorter than a full sentence but never more than three sentences in length. Importantly, they were analyzed in the presence of the preceding and following idea units to minimize the loss of vital, context-dependent information (e.g., author tone, intention).

Commonalities between idea units were tracked throughout the reading process via open coding and later refined into individual nodes within QSR NVivo 10 (Glaser, 1992; 1998). This
resulted in 11 unique nodes across the 14 Operative Thought Journals (Appendix D) and 11 across the Blackboard™ discussion posts (Appendix E). The investigator used these nodes to axially code all collected data and identify categorical themes emergent across both sources (i.e., Operative Thought Journals examined alongside corresponding in-game dialogue) (Appendix F) (Strauss & Corbin, 1990; 1998). This laid a foundation for understanding how and why particular individuals interacted with one another and the game in particular ways, feeding back into the investigator’s goal of determining which factors most influence particular agent-environment interactions in the game context, how and to what extent player goals emerge as a product of play, and whether or not player knowledge and experience tends to transfer between in- and out-of-game activities.

**Table 1. Stepwise approach to grounded theory analysis of Project TECHNOLOGIA data.**

| 1. | Import participant data from Blackboard™ (i.e., in-game posts) and GoogleDocs (i.e., Operative Thought Journals) into QSR NVivo 10 |
| 2. | Scrub identifying information (e.g., names, school districts) from imported data, assigning a randomly generated five-digit identification number to each participant |
| 3. | Read all discussion posts and Operative Thought Journals within their exclusive contexts (i.e., as separate datasets) |
| 4. | Identify common word, phrase, and concept usage within each dataset via inductive open coding |
| 5. | Record trends in word, phrase, and concept usage as unique nodes within QSR NVivo 10 |
| 6. | Use established nodes to review and axially code data across both datasets, first individually and then taken as one |
| 7. | Record emergent categorical themes as identified through the axial coding process |
| 8. | Establish recommendations for future research based on emergent categorical themes |
| 9. | Present findings to participants in service to data/analysis triangulation |

**Table 2. Number of Blackboard™ Posts Across Project TECHNOLOGIA episodes.**

<table>
<thead>
<tr>
<th>1.1</th>
<th>1.2</th>
<th>1.3</th>
<th>2.1</th>
<th>2.2</th>
<th>2.3</th>
<th>3.1</th>
<th>3.2</th>
<th>3.3</th>
<th>4.1</th>
<th>4.2</th>
<th>4.3</th>
<th>5.1</th>
<th>5.2</th>
<th>5.3</th>
<th>6.0</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Group 1</strong></td>
<td>6</td>
<td>5</td>
<td>8</td>
<td>6</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>2</td>
<td>3</td>
<td>5</td>
<td>9</td>
<td>5</td>
<td><strong>74</strong></td>
</tr>
<tr>
<td><strong>Group 2</strong></td>
<td>6</td>
<td>9</td>
<td>19</td>
<td>12</td>
<td>8</td>
<td>5</td>
<td>9</td>
<td>6</td>
<td>4</td>
<td>2</td>
<td>7</td>
<td>7</td>
<td>6</td>
<td>8</td>
<td>8</td>
<td>6</td>
</tr>
<tr>
<td><strong>Group 3</strong></td>
<td>5</td>
<td>7</td>
<td>3</td>
<td>9</td>
<td>3</td>
<td>11</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>9</td>
<td>3</td>
<td>4</td>
<td>2</td>
<td>7</td>
<td>7</td>
<td>4</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>17</td>
<td>21</td>
<td>30</td>
<td>27</td>
<td>15</td>
<td>20</td>
<td>14</td>
<td>10</td>
<td>9</td>
<td>14</td>
<td>13</td>
<td>11</td>
<td>20</td>
<td>24</td>
<td>15</td>
<td><strong>274</strong></td>
</tr>
</tbody>
</table>

² It is worth noting that while Groups 1 and 2 produced nearly the same number of discussion posts throughout Project TECHNOLOGIA, Group 3 produced approximately 50% more. All groups were comprised of teachers with similar experiences, workloads, and external responsibilities, and post content between the three groups was roughly similar in quality. This suggests that there may have been a quirk with Group 3 participation or an indirect motivating effect of Group 3’s instructional leader—the university faculty member. This question went unanswered during triangulation and debriefing but will be addressed in future implementations of the game.
Upon completion of the initial analysis, a second researcher—the university faculty member assisting as a Project TECHNOLOGIA instructional leader—reviewed approximately 20% of the total data using the coding scheme generated through the primary investigator’s open and axial coding. This served as an independent evaluation of code consistency, utility, and overall trustworthiness (i.e., peer debrief; see Morse, Barrett, Mayan, Olson, and Spiers, 2002; Spillet, 2003), yielding roughly 74% overlap with the primary investigator’s original code assignment. Misalignments between the two outlined parameters for a comparative discussion of findings and established areas where code clarity, precision, and specificity could be improved. Importantly, while the process resulted in minor modifications to a small number of code definitions, no codes were judged in need of elimination or replacement. In combination with participant member checking at the program’s close, data collection, parsing, and interpretation were determined to be qualitatively reliable within the scope of the study.

Quantitative Analysis

The combination of a limited sample size (n=14) and lack of standardized benchmark exams for Master’s-level technology coordinators made it difficult to take a purely quantitative research approach with Project TECHNOLOGIA. A conservative estimate calculated via GPower 3.0 suggested that 200-300 participants would be needed to create experimental/comparison groups capable of reaching appropriate statistical power to assess game effectiveness at improving student knowledge and application of the NETS-C/ISTE standards (i.e., a measure of achievement). As an alternative, the researcher attempted to use student grades, evaluations, and assignment completion rates as a means of triangulating individual differences between players’ success or failure in the gamespace and overall success or failure within the Master’s degree program. However, all participants finished the program with a grade point average (GPA) at or
very near 4.0 with zero missed assignments, creating a ceiling effect for quantitative e-portfolio and grade data that rendered it unanalyzable—there could be no correlation between program-level achievement and the knowledge, attitudes, or behaviors emergent throughout gameplay if all players achieved roughly equal GPAs. This resulted in the decision to focus on a purely qualitative analysis that could be used to lay a foundation for future quantitative work (e.g., studies of player achievement, motivation).

**Results & Implications**

The section below informs the three original research questions by cataloguing transfer, interaction, and intentionality in the context of participant thoughts and actions across *Project TECHNOLOGIA*’s implementation. While it was methodologically necessary to isolate each piece, the analysis was designed to emphasize their pooled value with respect to game-based instruction. Ideally, the findings will facilitate the development of optimal generator sets for *Project TECHNOLOGIA* and other educational technology training programs as well as inform existing instructional design strategies aimed at leveraging game mechanics toward improved goal adoption (i.e., intentional springs; see Shaw, Kadar, Sim, and Repperger, 1992).

**Transfer**

Though participants did not directly discuss positive or negative transfer in either their individual thought journals or collective roleplaying dialogue, many provided implicit references to apparent overlap (or lack thereof) between in-game and external events in their real classrooms. For example, instances of *unpleasant* frustration—defined by a reduction in engagement and/or motivation that negatively affected instructional goal adoption and/or attainment (Gee, 2003)—often grew out of imposed limits to player agency. When participants perceived instructor interference with their in-game actions (i.e., being forced into a specific avenue of approach), the
loss of control manifested as annoyance and frustration that inhibited further engagement with the
game’s content and subsequently affected the potential for transfer. Comments indicative of this
trend included:

*Tonya (Thought Journal [TJ] Episode Number [2.1]):* “Maybe it is part of the
‘game’ but it seems like the mission operatives are really hostile and unsupportive
of any ideas we have had so far.”

*Mandy (TJ 2.3):* “Getting repetitive again. Need to keep the conversation moving
forward”

*Becky (TJ 3.3):* “Diego has asked three times to allow demos of the iPad in small
groups and Biff keeps refusing him.”

*Winnie (TJ 3.1):* “I do think though that these episodes make sense but in the world
of the hypothetical, it is hard to REALLY suggest things in the way you would as
a true ed tech specialist in todays world.”

When set side-by-side with the episode dialogue to which these statements refer, it became clear
that complaints about instructor-limited agency were verifiable (e.g., the instructor did in fact deny
Diego’s request three times), and unfulfilled expectations made players hesitant to participate as
fully as they otherwise might have. Worse still, because the *Project TECHNOLOGIA* narrative is
so heavily socially constructed, the negative experience of one player had a tendency to taint the
experience for other players. During Episode 4.1, for instance, one highly active participant wrote
a lengthy response involving her frantic search for coffee, distracting the instructional leader and
other players from the game’s embedded learning objectives:

*Becky (Project TECHNOLOGIA [PT] Episode Number [4.1]):* ““You know what?
I have been on this balcony way too long. I’m going to look for some coffee.” He
doesn’t wait for permission and no one stops him. Diego grabs his backpack, jumps
the balcony, and begins to scale the wall. None of the crowd seems to notice this,
because they are fighting again. Diego joins the crowd and overhears a multitude
of different languages, clicks, tongue trills, guttural noises, but he does hear
English conversation every now and then...Diego has traveled extensively around
the Earth, how far out has the Starbucks chain finally made it? He sees a not so
intimidating looking alien coming this way. Having left his Babelfish at home, his
addiction to a stimulant trumps his fear of communicating with the unknown. He
already speaks three Earth languages and Biff and Duncan managed English..."Excuse me? Do you know where I can buy coffee?" "xoremlso." Great.... Well, at least that didn’t sound dangerous, like “I’m carnivorous and you look yummy......” Diego pantomimes drinking coffee, the alien shifts his head from side to side, uh oh, this better not be a mating ritual....Diego did get his iPhone back from the leaders before he went native, so he pulls it out and Googles pictures of coffee.....NOW the alien gets it!“Ahhhh....Buzz Buzz!” “Yes, please....Buzz Buzz!”

Two others similarly deviated from the game’s direction—perhaps to make the story more “interesting” or as backlash for feeling creatively hamstrung—by describing an elaborate, station-wide community festival and the outbreak of a fire:

Shawna (PT 5.2): “Adan holds the flame to a piece of paper... as it starts to smolder, Adan says ‘this lighter is like we were: full of potential but with nothing to ignite... it only takes a small ember- the Isurus of this place, to catch on and begin to spread the word... the paper lit up brightly as it became engulfed in flames... just like this paper, the interest and focus on technology is spreading far beyond what we could do alone...’ In his excitement, Adan did not see a piece of the paper burn and fall to the ground, catching the corner of Will’s cloak...”

Mandy (PT 5.3): “’Does anyone else smell something burning or is that just my fury?’ Will is completely amazed at how such a wondrous festival just went on for the past two days and somehow Duncan missed the whole thing... ‘Really...does anyone smell something burning?’”

The instructional leader was ultimately cornered into making one of two choices: 1) stray from the prepared narrative to undo the students’ actions and corral the group back into the game’s intended trajectory; or 2) marginalize the students’ contributions to the story and/or pretend they had not happened. The final decision—to ignore the students’ actions—maintained content integrity but reduced student investment in the game, further minimizing technology coordinator skill development and mastery. Shawna, one of the ignored players, actually responded to this instructional choice as part of her final in-game post:

Shawna (PT 6.0): If you want your operatives engaged, acknowledging what has been said and truly responding to that rather than apparently ignoring them if it isn’t what mission control wants to hear would help. As a believer in constructivism, I was frequently frustrated by what appeared to be more of a behaviorist approach
in which we were in a skinner box pecking out ideas until mission control finally dropped a pellet. I would have been more likely to continue trying to help if it appeared that any feedback was coming back that was a response to my thoughts. As it was, I constructed all kinds of ideas about RA and how it was run, not many positive.

Reflecting on the experience, the instructor noted that there appeared to be no ideal solution: learners would either engage with the game in some way that defeated the instructional intention or fail to engage it at all. Though some aspects of the experience might still transfer to real-world contexts (e.g., the notion that games could be used for instruction), negative attitudes, specifically, would worsen future gameplay, hamper positive transfer, and potentially generalize as negative attitudes toward game-based instruction or gaming writ large (Bandura & Locke, 2003; Magda, 2005). For an education system in need of innovation and modernization, this could actually impede research efforts to make learning environments more accessible, varied, and effective. It seems reasonable, then, to argue that avoiding unpleasant frustration should be at least as high a priority as instantiating any individual game mechanic—that is, instructors should keep players positively engaged not just through fun or interesting play but also the careful balancing of open-ended and linear storytelling.

Fortunately, Project TECHNOLOGIA participants provided several subtle nods to how implementers might achieve this end. Many attributed instances of pleasant frustration—moments where challenges existed within but on the outer edge of competency (Gee, 2003; 2004; Vygotsky, 1978)—to the application of prior learning from external course and program experiences. This included descriptions of high satisfaction during so-called teachable moments: sharing relevant understandings, thoughts, or ideas that they believed could or would assist their group mates. Students frequently alluded to film and other popular culture references (e.g., “Oh, this reminds me of the movie Contact,” Becky, TJ 2.2) as well as life experiences (e.g., “It reminds me of when
I studied abroad in Spain,” Becky, TJ 1.1) and individual goals that happened to align with instructor and program learning objectives when teaching their peers. Nadine, for example, stated:

_Nadine (TJ 2.2): “I think incorporating a tablet (a technology that is well-known to us) helped spark ideas. We’re linking digital literacy skills that we learned in previous coursework”_

When this notion was shared with others, it encouraged greater willingness to think creatively, take intellectual risks, and make positive shifts in attitude:

_Tonya (TJ 2.2): “I am liking this a bit more now that some of the theatrics have died down and it is more content driven…I finally feel like this is more of a learning experience that we are being appreciated for participating in…”_

On occasions where participants described teachable moments as especially personal, there were corresponding increases in demonstrations of positive transfer through the incorporation of course, program, and real world situations (e.g., classroom instruction). In Episode 1.1, Dani suggested *Project TECHNOLOGIA* could serve as a model for the development and revision of her own lesson planning:

_Dani (TJ 1.1): “This seems like it would be awesome to do with my 5th graders in Social Studies around the American Revolution. They could take on roles such as the King of England, Patriots, Loyalists, tax collectors, British citizens, etc…I think they would love it.”_

Others jumped on this idea, using it as the foundation for their own big picture thinking. Becky said it made her want to “be the tech coordinator” by “learning more about the people [she was] teaching.” This involved experimenting with elements of what Dani had described by testing it on her real world students: “with one [of my classes] I am going to give them an assignment a day that in some way involves their cell phones” (Becky, TJ 2.3). That experience, in turn, informed her approach to technology implementation two episodes later:

_Becky (PT 2.3): Diego had a bit of an out of body experience and had mentally been back on earth dealing with an extra class assigned to him and work, but he is back now. He doesn't have time to worry about Rheegan, she will indeed get over_
it. Although it does help to see that she cares and protects her people deeply. All they can do is show her what they can do. He also realizes now why at every IEP meeting for his daughter, he is told he is the sanest, easiest parent to work with. Everyone is always crazy and overwhelmed, hissy fits don’t help but they make for great comedy writing.

Diego looks away from the tablets and speaks:

"Since we have the tablets, and we want to move forward instead of backward with literacy, why don’t we start with one or two "apps" that could be beneficial and slowly introduce them to some families or groups that may be interested? Do you have a town hall or meeting place where we could promote the idea?"

Statements like these indicated that Project TECHNOLOGIA may help educators transfer content from the game to in situ instruction and back again. With further investigation, it might be possible to identify precisely how program administrators can induce back-and-forth transfer between the game and live classroom environments to scaffold more thoughtful, effective action research than traditional pre- and in-service teacher professional development (e.g., Bobrowsky, Marx, and Fishman, 2001; Lawless and Pellegrino, 2007; Penuel, Fishman, Yamaguchi, and Gallagher, 2007; Slota, Young, Choi, and Lai, 2014). Ideally, this would improve the rate and efficacy of data-driven pedagogy adoption among in-service teachers and reinforce the application of degree and training program content at the individual classroom level (Barab, Gresalfi, & Arici, 2009).

Interaction

With respect to this study, the term “interaction” is not simply employed as a synonym for communication but as a contrast to the empirical research term “intervention.” While there is value in examining gameplay as a treatment for certain educational conditions (e.g., determining whether or not a game has helped improve achievement, motivation, etc.), that approach provides little information about the learning processes underlying the agent-environment interaction (see Young, 2004; Young et al., 2012). This may seem like a semantic quibble, but failure to understand the difference between interaction and intervention has the potential to reinforce undesirable
habits, trends, and assumptions about what constitutes effective and ineffective game-based instruction. No game is a single independent variable leading to a single or small number of outcome variables in every player but rather a complex system of continuous agent-environment interactions—a medium through which individuals communicate perceptions, actions, and goals to themselves and others (Slota & Young, 2014).

For this reason, analysis in Project TECHNOLOGIA was conducted with attention chiefly paid to the context in which interaction occurred, including both writer and audience perspectives as well as the thought processes associated with the perceptions and responses of both (where available). It was assumed that story co-creation took place in moment-to-moment interfacing of the co-authors and text that unfolded as situated action—logically, given the structure of the program, it would make little sense to argue that the Project TECHNOLOGIA narrative was created or interpreted in the head of any one instructor or student since several individuals contributed to the story as it moved forward. Moreover, on-the-fly participant-content-environment interactions led to the detection of new and different affordances offered by objects, characters, and settings, in turn presenting an array of evolving user goals (see Intentionality). Agency and intentionality defined how individuals interacted with information, and the narrative built as a function of player and instructor interaction belonged to all participants simultaneously (Young, Slota, Travis, & Choi, 2014).

Operative Thought Journals yielded the richest source of interaction data, offering insight into how participants viewed exchanges between themselves, their fellow players, and the game. Several noted that the most engaging and memorable experiences came as a result of dialogue, and player-player, player-instructor, and player-game interactions that reinforced Project
 TECHNOLOGIA’s collaborative nature tended to increase comfort and satisfaction with roleplaying. Reaction types included perceptions of improved partnership:

_Gretchen (TJ 3.1):_ “I found myself giving some suggestions for next steps and also questioning my fellow avatars this week, which I think is the right direction in which to head. I think that I will continue to engage others, rather than just posting what I think or agreeing/disagreeing with the other posts.”

_Mandy (TJ 2.2):_ “we seem to each be spouting our own agendas, but now it is time to begin conversing and coming to a consensus.”

Peer appreciation and encouragement:

_Winnie (TJ 3.2):_ “Gretchen did a great job stepping in and initially organizing the chaos in a way that I envision her controlling her elementary classroom (sometimes you need to really treat adults like kids).”

Curiosity:

_Dani (TJ 0.0):_ “My peers playing Adan and Diego have me intrigued. Bella mentioned a cookie behind the statue, I’m sure for good reason. I’m trying to figure out why. Becky seems like an adventurer- curious to see the world and make sense of it. I’m guessing she has a constructivist component to her character.”

Commiseration:

_Mandy (TJ 2.3):_ “Missing many in our group - understandably so. This semester has been overwhelming with the three courses, the amount of time that is needed and with SBAC and work.”

Playful teasing:

_Gretchen (TJ 1.1):_ “I love seeing “frustrated” posts from [the instructor] and I wonder if he is truly frustrated because we’ve been a little slow on the up-take. ;)”

And the desire to further engage peers through storytelling:

_Dani (TJ 1.1):_ “I hope as the story develops, I can be bolder when I can connect to experiences earlier in the mission. I hope to show a change in my character…After reading Sue’s post in our Aliyah group, I tried to make my post a little more creative since the tutorial post.”

_Becky (TJ 1.1):_ “I am trying to find a balance between the game and the mission of being a tech expert. I want to have fun with my character and make him say outrageous “let’s do it” things but he also has to be an expert.”
Such reflections corresponded with in-game character dialogue and appear to have influenced a change from individual to group-centric problem solving over the course of game implementation for some players. For example:

Tonya (PT 1.2): Adan takes a small step forward with hopes of delivering a big idea... “We need to make sure that we create a population of individuals who are exactly that- individuals. Clearly, we all are quite proficient at speaking for ourselves in this group and expressing our own ideas. Why not let the people get dirty, jump in and test the waters? Offer enough choice that they can experiment and then make their own decisions, creating a personal philosophy? I feel that once we know who we truly are, then we can begin to collaborate effectively." Adan lets his words sink in, looking for approval from the others.

Walter (PT 1.2): Will has been listening quietly in the background. Diego's thoughts and Duncan's initial approval provides a starting point. But then he asks "If we are to develop an educational plan to nurture free independent thinkers, what is the framework that we need to use? In other words, we need to know more about the society of Remmlar Array, the laws that govern them and their goals and principles. We may also need to know about their history, as the past will influence their future".

Here, participants acknowledged one another’s ideas and contributions to the conversation, but interaction was primarily driven by individual players’ real world motivations and approaches to the problem rather than building consensus about which direction to go next (i.e., agreeing on a shared vision for the future of Remmlar Array’s education system). By the end of the program, however, the students were much more cognizant of how several ideas could be merged into a single technology coordination trajectory:

Tonya (PT 5.2): Adan is thrilled to hear Aliyah's idea using an app like Twitter. As a former tweeter, Adan knows how informative (and even entertaining) a social network could be. After listening to Lienne, Adan adds in to the conversation: "I think we need to combine the two ideas we have here: Twitter and a discuss [sic] of Pedagogy and Content. Let's run with the social network idea, it seems like much of the citizens have begun to play around with this type of app already so they should have a general concept understanding of how these programs work. What if we took more of a personalized-page approach to a network, like our old Facebook. This way, each member could set up their page and then connect to other citizens with common beliefs. They can then create groups, even pages, that
promote their beliefs. Let's create this network and include ourselves as members. We can facilitate groups based on our beliefs and then collaborate with one another to come to a consensus. This way, EVERYONE has the opportunity to make their voice heard, if they would like.” Adan thinks that a more in-depth social network might please Biff even further, and appeal to Rheegan, who just loves to state her opinions to the masses.

Walter (PT 5.2): Will turns to [Adan]: “I think I see where you are going. While we have the technology piece, we should also consider the content and pedagogy aspects. Regarding the content, we should have a way to ‘filter’ and ‘validate’ the information that will be shared via our social networks. We can build this into our framework and have the subject experts check the accuracy and reliability of the data. A wiki could work in this case. Regarding the pedagogy, I believe we had already agreed that a student-centered and social learning environment is the way to go.”

This shift in collaborative approach implies that there might be value in scaffolding particular strands of interaction between co-writing members of a team. Rather than allowing collaborative problem solving to unfold on its own, the instructor could induce group-centric thinking and, by extension, improved peer-to-peer collaboration through carefully worded leading questions and statements (e.g., “Rheegan, despite her hesitation to agree to constructivist pedagogy, turns to Will and Adan: ‘Do you foresee some way that this Twitter and wiki idea could also include an evaluation measure?’”). Juxtaposed with a more traditional learning environment, the goal would be less telling students what they need to know and more subtly encouraging external research and identification of overlap between ideas (i.e., utilizing case-based teaching). This would help frame a “time for telling” (see Schwartz and Bransford, 1998) through which the instructor could organize student findings, opinions, and ideas as the basis for future direct instruction about related topics, resources, and information (Young, Slota, Travis, & Lai, 2014).

Likewise, by placing increased emphasis on the significance of context-driven interaction in game-based learning environments, it may be possible to solve a common problem with the study and implementation of educational games: bridging content from the virtual world with
events in the real world. Extending their argument from Papert’s (1997) critique of school reform, Young et al. (2012) and Slota, Young, and Travis (2013) suggested that educational researchers need to significantly alter traditional pedagogical strategies in acknowledgment of the importance of student-student and student-instructor interaction. Young, Slota, Travis, and Choi (2014) further recommended that instructors purposefully model storytelling associated with narrative-as-perceived and narrative-as-social organizer to shape learner utilization of prior knowledge. Additional work is required to develop best practices for this approach, but if the emergent interaction outcomes associated with Project TECHNOLOGIA are any indication, roleplaying could be a powerful way to encourage transfer through guided agent-environment (i.e., student-student, student-instructor, student-game) interaction.

**Intentionality**

The prior experiences individuals carry with them can have a dramatic effect on intentionality in unique educational contexts (Barab & Roth, 2006; Young, 2004). This may be the reason why Project TECHNOLOGIA participants universally described their perceptions and actions, both within and external to the gamespace, as related to pre-existing and emergent goals. Though some began their participation without any definitive expectations for the game, many had at least partially outlined a projected track with an accompanying attitude falling somewhere between optimistic (e.g., “I want to have fun with my character and make him say outrageous ‘let’s do it’ things but he also has to be an expert,” Becky, TJ 1.1), neutral (e.g., “my motivation is to answer the questions, rule follower that I am… I try to argue the points that I believe through the behaviorist approach,” Shawna, TJ 1.2), and pessimistic (e.g., “This is really not my thing. Too slow paced, too much make believe,” Marsha, TJ 1.1; “I am not into the Dungeon and Dragonsy language, it is rather annoying,” Pamela, TJ 1.1). Such polarization might be expected given the
division in prior experience among self-professed gamers and non-gamers—particularly adult learners—but it was surprising to see that the rationale underpinning overall outlook was oddly consistent for gamers and non-gamers alike. In fact, all 14 participants described the same basic combination of determinants for their frame of mind during gameplay, including:

1) Expectations for what the game could or should be;

Pamela (TJ 1.2): “The language and the script is hard to read and follow. I wish there was a visual world that there were cartoon figures and it looked like a game. Without the visual, it is just another threaded discussion. And, WHY, can’t I speak in the first person? Why the 3rd person?”

Walter (TJ 1.1): “Without seeing other character faces, it is a bit challenging to interact them. Looking at gestures and body postures is a very important (if not the most important) part of communication. One can tell emotions, state of mind, agreement or disagreement with body reactions.”

Becky (TJ 2.1): “I can’t help it if I’m the only one whose father read them the Lord of the Rings trilogy when she was four and never missed an episode of the X Files in college.”

2) Individual beliefs about education;

Gretchen (TJ 1.1): “I think that I want to go with Rheegan since she seems to have a civic-minded outlook and that matches my personal outlook on education, but I’m not sure if I should be looking for someone who shares my ed theory POV.”

Becky (TJ 2.3): “I’m having a very hard time with Rheegan’s hostility. I know that my district is very technology oriented and they are encouraging the BYOD and wifi policy.”

Nadine (TJ 3.2): “The crowd is getting very animated about changing the educational system. This is probably an accurate animation of how real people would act if there were BIG changes to the education field.”

And 3) events unfolding in the program and/or one’s personal life;

Mandy (TJ 2.3): “This semester has been overwhelming with the three courses, the amount of time that is needed and with SBAC and work. Unfortunatley, I don’t feel that I’m investing the most into it. Honestly, just a time factor.”
Dani (TJ 1.1): “Today, this felt like a chore, as I have a lot of other coursework to complete because it was a busy week. It takes me a little while to reread the episodes and compose my response.”

Bella (TJ 2.1): “Still feeling overwhelmed at having another “course” to attend to when I already have three other courses on my plate.”

Winnie (TJ 1.1): “I would say that the long descriptions are interesting (I feel like I am reading a sci-fi novel) it is hard to stay engaged knowing all of the other work involved in the other courses we are taking as well as the high demand of my job. I hope my response suffices though.”

This has important implications in the context of Project TECHNOLOGIA given that participating students appear to have shared pre-existing goals regardless of the experiences comprising their respective life-worlds (Barab & Roth, 2006)—namely that the shared determinants described above imply student participation was not ultimately a question of whether but how (i.e., the attitude associated with collaborative participation). Of course, the individuals participating in Project TECHNOLOGIA shared a common occupation (i.e., K-12 educators), roughly similar interests (e.g., helping others learn), and at least one major goal exclusive of gameplay (i.e., successfully completing the overarching Master’s degree program), yet if the same basic trend holds true for other forms of game-based instruction, it may suggest that the educational community’s current approach to game-based learning research rests on a troublingly weak foundation. Designers often assume that players (i.e., students) automatically share an intention to succeed at the game and, consequently, the course or program (Young et al., 2012; Young, Slota, & Lai, 2012). However, even if those students share an intention, there is no guarantee that it will align with instructor goals, course objectives, or the game in question (e.g., fulfilling personal goals over game-related goals).

Furthermore, students with a shared goal (e.g., finishing the game) can also exhibit divergent attitudes about whether or not a particular path to success is worth their time, attention,
and effort (e.g., playing by the instructor’s rules versus playing by their own). Since gameplay toward any goal means time and time is money in the commercial game industry, player intention is usually not a major concern because there is little or no need for individual players to play a particular game in a particular way (unless it impedes the gameplay of others), but in an educational setting reliant on standardized tests, instructional fidelity, and transfer, there are numerous economic, political, and social consequences for diverging from the optimal instructional trajectory. How intentionality might affect achievement in educational gaming environments is a question that desperately needs attention from learning scientists, and the answer could provide insight as to the way game-based learning research can become more granular and extensive in nature.

Making such a push will not be easy or swift, but one starting point might be the examination of goal adoption as it pertains to particular players playing particular games in a particular educational context—something that could be accomplished as simply as using a microblogging notification tool (e.g., Twitter) to have players periodically stop what they are doing and record their in-the-moment intentions (e.g., Csikszentmihalyi, 1990). In Project TECHNOLOGIA, emergent player intentions were most closely tied to non-player character behaviors, meaning that feedback from instructors—in the form of dialogue and action among characters like Rheegan, Biff, and Duncan—had the greatest effect on whether or not students would adopt a particular goal and how they would attempt to meet (or avoid meeting) it:

Tonya (TJ 3.1): “I am just trying to make “Duncan” or “Rheegan” happy at this point with any suggestion that I feel would work regardless of what a Behaviorist would say.”

Shawna (TJ 1.2): “I have to say, while I am approaching the character much as I myself would speak (acting was never my thing) - I was sorely tempted to punch Bif in the face, just to see what would happen… you planted a seed… and bif for no other reason that all I can think of is “hello, McFLY!!!”).”
Winnie (TJ 1.1): “I think my character is becoming enthralled with Biff’s vision for this world… I made it so that Lienne creates an Ally with this visionary character.”

Becky (TJ 1.2): “Rheeghen needs some calming down. I’m going to have to work with her. I once read a book (well skimmed it), called Even Mystics have Bills to Pay, I’ll work that in somehow.”

While not all new goals were directly related to program content (e.g., physically attacking Biff), many involved pulling external material into the gamespace, including readings, prior coursework (e.g., learning theory), and real world situations drawn from the in situ classroom. This was especially valuable with respect to fostering a group-centric approach to the unique technology coordination problems posed in the game prompts (see Interaction). Additionally, from an instructional perspective, it appeared to apply pressure toward the fulfillment of particular learning objectives while also keeping students invested in play, collaborating with peers, and thinking critically about their contributions to the project. Paired with extant research about anonymity in computer-mediated communication (e.g., Dubrovsky, Kiesler, and Sethna, 1991; Kiesler, Siegel, and McGuire, 1984; Lea, Spears, and de Groot, 2001), this might mean that interaction between players and non-player characters affords an opportunity for learners to perceive invariance between in-game and external experiences without experiencing anxiety about direct interaction with an instructor. Capitalizing on such an affordance would make it possible for instructors to more effectively seed up-to-date technological, pedagogical, and theoretical information into live classrooms by way of storytelling—something viewed as quite difficult within professional development and pre-service teacher education circles (e.g., Bobrowsky, Marx, and Fishman, 2001; Lawless and Pellegrino, 2007; Penuel, Fishman, Yamaguchi, and Gallagher, 2007; Slota, Young, Choi, and Lai, 2014). Though it is an as-yet unanswered empirical question, it could serve
as the basis for a program of research aimed at developing intentional springs for other educational
technology and/or game-based programs of study.

**Limits of Interpretation**

As with any study of human thinking and behavior, data collection and analysis throughout
*Project TECHNOLOGIA* was subject to bias in individual participant and investigator intentions,
preconceptions, and interpretations. In their review of why novel approaches to technology
implementation fail, Slota, Young, and Travis (2013) affirmed that education research is often
plagued with “situations where participating educators “do it for the researcher(s)” or for the status
of being part of the research team, or the resources involved in a grant project” (pp. 42). Given the
nature of the Master’s program from which participants were recruited, it is possible that some
could have misrepresented their own judgments, ideas, or comments believing that they would
help or earn favor with the investigator or program administrators. Likewise, if a particular
participant or group of participants had some intention to willfully misinform the investigator or
otherwise hurt the project, they could have entirely misstated their thoughts within the “Operative
Thought Journal.”

It is equally plausible that the concepts, feelings, and thoughts associated with play were
simply too complicated to accurately capture in self-reported text. While Norris (2007) argued that
this does not inherently invalidate qualitative research, it does pose an on-going problem for
researchers seeking to equate ethnographies, grounded theory studies, or other qualitative work
with more traditional quantitative approaches. At issue is the fact that humans are multifaceted,
possessing attitudes and behaviors that change moment-to-moment as a function of environmental
context, prior experience, and emerging goals. Ideally, triangulation with participants, peer review,
and repeat study can minimize bias, but until statistical models and technologies offer greater
specificity than the standard normal curve, granular assessment of participant thought and action will be limited to qualitative investigation at the individual level.

To minimize bias, the investigator refrained from teaching or grading participants throughout the game-based program’s duration (i.e., the period during which the game/program primarily took place), and participants were not required to contribute to the game as part of their courses or Master’s program plan of study. They received a face-to-face debriefing session as part of their final week of the Master’s educational technology program, and at that point, the investigator listened and responded to questions, concerns, and feedback that could inform the analytical process. Additionally, the investigator shared his findings with the participants to ensure that the analysis accurately reflected their individual intentions, goals, and understandings of what was written and transpired within each team. The open and axial coding process was conducted under the advisement of a second researcher and verified through a combination of re-coding and peer debriefing once the initial nodes were deconstructed for the purposes of cataloguing thematic outcomes across the data.

Due to limited sample size (n=14), unequal distribution of participant sex, non-random sampling, and the qualitative approach to data collection and analysis, the findings from this study only reflect the knowledge, attitudes, and behaviors of those who chose to participate. The results are not generalizable to a larger population and should not be used to draw conclusions about Master’s educational technology programs, graduate students, or learners as a whole. However, the study does provide a potential starting point for future game-based learning research aimed at examining transfer, player-game-context interaction, and intentionality. Should this occur, it will be important to establish the individual differences between the participants featured in this study and those of any subsequent investigations.
Conclusions

This examination of player-instructor-game dynamics has yielded insights about how gameplay affected transfer, interaction, and intentionality in the context of Project TECHNOLOGIA. As noted above, self-reported player perceptions of non-player characters suggest that the act of story co-creation affords opportunities for instructional induction of goals, and students who experience increased pleasant frustration may be more likely to transfer material between the game environment and their in situ classrooms. Additionally, because student-student and student-instructor dialogue led to greater comfort with roleplaying and improved group-centric problem solving, it seems reasonable that social interaction in the game environment could be deeply related to success in meeting pre-established instructional goals as well as emergent student goals.

These results are a first step toward better defining methodological approaches for studying educational gaming in K-12 and university learning environments. There are still many questions about how games can and should be designed, and a substantial percentage of studies have not taken into account goal emergence as a factor that may affect end variables such as achievement and motivation. Understanding the interaction between player intentionality, the instructionally-relevant game, and student outcomes may be embedded in the way an instructor tailors a game’s story toward student actions, perceptions, and choices, meaning that agent-environment interaction is tantamount to instructional success. This is not to say that open-endedness or unlimited student agency are ideal for all educational games, but well-guided player activity in a text-based roleplaying game—as facilitated by a compelling narrative—may be the key to guiding adoption of the student intentions for learning assumed to be present in other game studies. If true, co-writing and ownership of an educational game should be made at least as high a priority in
educational game development as the game’s other mechanics, and researchers should more thoroughly investigate the connections between educational gaming and problem-based learning environments of the past.
References


Travis, R., Slota, S. T., & Young, M. F. (In Press). Leaving the cave without losing the transfer: ARGs and integrated performance in Operation ARETE. *GLS 9.0 Conference Proceedings*.


CHAPTER III

World-Building 101:
The Application of Contemporary Learning Theory in Game Design

Abstract: Commercial and educational game developers frequently draw upon the same principles of problem-based instruction to create cooperative, engaging, and “fun” gamespaces. Yet, there is little information about the way game mechanics, narrative structures, and peripheral tools (e.g., forums, cheat guides, mods) influence the skills needed to be a successful 21st century learner. In response, data collected from in-game interactions of 14 practicing educators were used to conduct a qualitative grounded theory analysis of a text-based alternate reality/roleplaying game developed under a situated cognition, Technology, Pedagogy, Content Knowledge, and Learning Theory (TPACK-L) framework. Findings suggest that TPACK-L, combined with the ADDIE instructional design model, may have multiple affordances for iterative design and the alignment of commercial and educational game developer goals. Recommendations for further research are provided.

Commercial game developers rely upon many of the same principles to create cooperative, engaging gamespaces as learning scientists whose primary goal is to construct problem-based learning activities (Gee, 2003; 2004; Slota, Young, & Travis, 2013). In observation of this relationship, Gee (2004) noted that “deep learning requires an extended commitment [that] is powerfully recruited when people take on a new identity they value and in which they become heavily invested—whether this be a child “being a scientist doing science” in a classroom or an adult taking on a new role at work” (pp.18). Much like real world settings, games place their players in rich contexts that require investigation and evaluation to overcome challenges related to particular domain content (e.g., helping Super Mario save the princess from the villain, Bowser, by applying prior experiences in the context of particular in-game mechanics and environments). It follows that educators should be able to capitalize on the connections between problem-based learning and popular games like Assassin’s Creed, BioShock, and World of Warcraft to re-imagine and reshape classroom instruction (Young, Slota, & Lai, 2012).
Yet, there is little empirical evidence concerning the way game mechanics, narrative structures, and peripheral tools (e.g., forums, cheat guides, mods) guide instructional designs that target the skills needed to be a successful 21st century learner. Meta-analyses of extant educational gaming literature (e.g., Tobias and Fletcher, 2011; Wouters, van Nimwegen, van Oostendorp, and van der Spek, 2013; Young et al., 2012) suggest that an overwhelming majority of game studies have focused on the relationship between games and dependent variables, such as achievement, motivation, and engagement, to declare games as either “good” or “bad” for education. By contrast, few have taken a bottom-up approach aimed at cataloguing the way games are actually played by individual players, and virtually none have addressed the notion that even if individual gamers (or students) share intentions for play, there is no guarantee that their definitions of success or paths to fulfilling a target goal will be isomorphic (Young, Slota, & Lai, 2012). This leaves the instructional design community with two important questions about the present approach to educational gaming research and development:

1. Which game elements most influence particular agent-environment interactions among particular players playing a particular game in a particular context?

2. How can and should contemporary theories of human thinking and learning factor into game design and implementation?

Here, I propose a working premise based on a grounded theory analysis of findings from a 24-week, text-based alternate reality roleplaying game played by Educational Technology graduate students at a large, public university. This approach utilizes granular player perceptions, ideas, and interactions to identify why and how individuals play the given game in particular ways. It was designed to compare educational games with established problem-based learning tools, facilitate the improvement of methodology among learning scientists, and lay the groundwork for new research trajectories within the field of game-based learning. Optimally, this will help bridge the
schism between commercial and educational game development to advance design parameters for the benefit of economics, play experience, and learning. Recommendations for further development follow.

Problem-Based Learning as a Foundation for Educational Gaming

Problem-based learning (PBL) was first introduced at McMaster University Medical School in the 1960s as a means of crafting realistic, complex problem-solving opportunities for aspiring medical students (Barrows, 1996). The program, which has since been repurposed for law, engineering, and accounting, presumed that students must explore and construct learning in order to develop a sense of ownership and understand what it means to be a real-world doctor, lawyer, engineer, or accountant (Baker, 2000; Maudsley, 1999; Mills & Treagust, 2003; Milne & McConnell, 2001). The underlying framework was designed explicitly for students to utilize learned skills to demonstrate problem solving in richly authentic contexts and reflect on their prior experiences with similar tasks (Wood, 2003).

The problem solving and critical thinking associated with PBL has made it well-suited for K-12 instruction and assessment under the situated cognition paradigm (see Brown, Collins, and Duguid, 1989). Not only are the activities more richly contextualized than in most direct instruction classrooms and standardized testing contexts, but they are continuous and formative in nature. They represent an on-going progression that underscores comprehensive student achievement and instructor feedback that further enhances performance (Crooks, 2001). Student-instructor dialogue resulting from interactions within a PBL environment has the potential to shape instruction in real-time and accommodate fluctuations in demeanor, attitude, and domain knowledge. When used in place of or in conjunction with summative standardized assessments, it allows the evaluator to examine and measure the problem-solving process in addition to the end
result (Boston, 2002). This has been shown to increase student engagement and provide a means by which test developers can address threats to validity and reliability that affect the open-ended response sections of high stakes exams (Gikandi, Morrow, & Davis, 2011).

Additionally, because PBL activities prompt students to self-evaluate, self-assess, and set new goals for themselves, they inherently draw on the top three domains of Bloom’s Taxonomy (Marzano, 2003; Stiggins, Arter, Chappius, & Chappius, 2006). As Bransford and Stein (1984) highlighted in *The IDEAL Problem-Solver*, “[Problem-solving] frequently isn’t learned because it isn’t taught. In school, for example, we are generally taught what to think rather than how to think…[People] often regard problem solving as a task students are asked to perform at the end of a chapter in a textbook or as a process relevant only to intellectual puzzles” (pp. 3). When students engage in problem solving-rich reflection rather than focusing purely on memorization—typical of content domains subject to high stakes testing—they tend to perform better and with less guidance in other problem-solving situations (Kwon & Jonassen, 2011).

The goal of both instruction and assessment, then, should be to emphasize the broader elements of problem solving: 1) identifying and defining the problem, 2) exploring alternative solutions, 3) acting on a chosen plan, and 4) examining and reflecting upon the short- and long-term effects of the action (Bransford & Stein, 1984; Polya, 1945). Unfortunately, despite this structure being paramount to the development and evolution of complex cognitive function, formal education settings have come to limit problem-based learning opportunities in favor of emphasizing performance on summative assessments like multiple choice tests. Such omissions prevent schools from meaningfully assessing the demonstration of concepts and procedures associated with real world doing. As a result, there is reason to be that instructors would benefit
from employing problem-based activities over and above repeated testing to create more effective “times for telling” (Schwartz & Bransford, 1998; Young, Slota, Travis, & Choi, 2014).

**The Intersection of Problem-Based Learning, Game Design, & Education**

Bruner (1961) argued that discovery should be the primary driving force behind all instructional design because students learn most efficiently when provided with opportunities to utilize their existing knowledge to assign meaning and organization to new experiences in a given content area (Bruner, 1961; 1966). To that end, he suggested adherence to four basic principles that would promote the creation of effective constructivist, PBL pedagogy, including: 1) ensuring that the learning environment was experience and context-rich in a way that compels students to learn; 2) ensuring that instruction was well-designed such that it spirals along an accessible, accumulative path toward an end objective; 3) ensuring all learning was deliberately planned to remain open for extrapolation and further study by the learner; and 4) ensuring that learned behaviors were reinforced with rewards and punishments to further encourage or discourage them (Bruner, 1966). Commercial game design typically follows these same guidelines (D. Norton, personal communication, July 8, 2014; Proctor, 2013), and as emphasized in Gee’s (2003) 36 Learning Principles, both educators and game designers must encourage students and players to become invested in complex, self-directed processes in order to reach the goals they have been encouraged to adopt (e.g., learning objectives). This is directly related to educational gaming given that games offer constant player feedback with respect to performance, and students can be led to adopt intentions for learning, problem solving, and conflict resolution when instructors draw attention to invariants between current and prior experiences (Rothman, 2010).

The strongest thread tying Bruner’s constructivist model to game design and pedagogy is perhaps his primary motivation for promoting context-rich problem-solving environments: the
belief that academic content possesses numerous affordances for co-action and historical storytelling that are often omitted from school curricula despite their essential role in conveying the nature of being a real-world professional. *The Culture of Education* (Bruner, 1996) described the function of narrative co-construction in pedagogical design by classifying education as a series of clear, distinctive processes that extend beyond rote information:

Our instruction in science from the start to the finish should be mindful of the lively processes of science making, rather than being an account only of ‘finished science’ as represented in the textbook, in the handbook, and in the standard and often deadly ‘demonstration experiment.’ We live in a sea of stories, and like the fish who (according to the proverb) will be the last to discover water, we have our own difficulties grasping what it is like to swim in stories…Surely education could provide richer opportunities than it does for creating the metacognitive sensitivity needed for coping with the world of narrative reality and its competing claims (pp. 127).

Real-world science, as opposed to the earth science, chemistry, biology, and physics taught in the K-12 environment, tends to be incremental and cannot be sufficiently replicated within highly-structured, 45-minute class periods (Bruner, 1996). Though many schools offer science blocks during which students can complete labs, in-class experiments tend to teach decontextualized information resulting from an isolation of science concepts and standardization of learning. Instead, students should be encouraged to co-develop hypotheses rooted in richly authentic situations the same way commercial game players are encouraged to work with designers (via in-game text, dialogue, and plot details) and other players to develop hypotheses that facilitate the conquering of various enemies, villains, and other in-game challenges. This would validate trial and error as part of the learning process (i.e., “productive failure”; Kapur, 2006; 2008) whether used to overcome the ‘end boss’ of a well-designed game or evaluate group responses to a *Jasper Woodbury* prompt (Cognition and Technology Group at Vanderbilt [CTGV], 1990), and it would
foster player-player and player-game interfacing to induce co-labor across varied zones of proximal development (Lave & Wenger, 1991; Vygotsky, 1978).

Yet, while some universities and K-12 institutions have tried taking a game- and/or problem-based approach—for instance, using Portal to supplement logic and problem-solving skill development (Abbott, 2010), World of Warcraft to facilitate secondary language learning and cultural competency (Zheng, Newgarden, & Young, 2012; Zheng, Young, Wagner, & Brewer, 2009), or Lord of the Rings Online to scaffold comparisons of modern and ancient Greek storytelling traditions (Maton, 2012; Travis, 2010)—it is not the norm, and it is not well-understood as a matter of educational game development. Young et al.’s (2012) meta-review noted that “Only a handful of research articles have provided in-depth descriptions of the game mechanics and algorithms utilized in their studies, making it difficult for experimental follow-up and replication” (pp. 81), and in spite of administrators often supporting educational gaming as a pedagogical tool (Wlodarczyk, 2012), designers have seldom examined what and how students are actually learning. Instead, assumptions are made about goal orientation, fulfillment of objectives, and co-action within the gamespace that are not rooted in any particular conceptual framework (see Young, Slota, and Lai, 2012). This is an issue that undermines the rationale for introducing games into educational environments in the first place, and it can only be resolved by better attending to the role of contemporary learning theory in educational game implementation.

TPACK & TPACK-L

As established by Tobias and Fletcher (2011), Young et al. (2012), and Wouters, van Nimwegen, van Oostendorp, & van der Spek (2013), the mere utilization of a game for learning does not necessarily equal effective pedagogy. The techniques underlying gamification, for instance, try to apply well-known behavioral reinforcement principles that have been leveraged
across educational, corporate, and other environments for decades (Horner, Sugai, Todd, & Lewis-Palmer, 2005; Sugai & Horner, 2009). Though this is not to say that behavioral skill-building through a spiral curriculum is without benefits (Bruner, 1966), behaviorism and its application in education—game-based or otherwise—are often inelegantly applied and instructionally useful only to a point.

This is why the integration of contemporary learning theory into the design process may be helpful with respect to addressing effectiveness in both the educational and commercial game development communities. Koehler and Mishra (2009) first laid the foundation for improvement through their Technological, Pedagogical, and Content Knowledge (TPACK) framework, initially developed to define and document the complex dimensions of blending technology with established instructional methods and domain knowledge. The framework emphasizes the intersection of technology, pedagogy, and content (Figure 1), and a number of studies have supported its use for teacher evaluation and professional training program development (e.g., Hofer and Grandgenett, 2012; Koh, 2013; Mouza and Wong, 2009; Schmidt et al., 2009).

Yet, simply knowing about a technology (e.g., games) and having the skills to use it are insufficient when faced with on-the-fly, emergent classroom dynamics of large-scale social settings with multiple users (Slota, Young, Choi, & Lai, 2014). As Slota and Young (2014) argued,
many individuals can share intentions for technology use, but that does not imply those individuals will also share desired paths to achievement or emergent goals as they participate in the unpredictable interactions of classroom learning. This means on-the-fly actions of implementers (e.g., teachers, players) can intentionally or inadvertently inflict fatal blows to intended designs (Slota, Young, & Travis, 2013). In education, this has led to the downfall of classroom technology integration programs like Logo (Papert, 1980), *The Adventures of Jasper Woodbury* (CTGV, 1990; 1993; 1994), and *Second Life*’s Teen Grid, and in commercial gaming, it has destabilized the mechanics of titles like *Mario Kart* (e.g., online hacking; Kinsley, 2014), *League of Legends* (e.g., bullying and/or “griefing”; Lin, 2013), and *Diablo II* (e.g., gold farming, “bots”; Lopez, 2012). Simple reward structures loosely based on behaviorism are simply not robust enough as an underpinning learning theory to contend with these types of multifaceted problems, and developers—educational and commercial—have seldom considered alternative theories of human thinking and learning to help shape agent-environment interaction, induce goal adoption, and maintain program fidelity (Young et al., 2012).

Addressing such issues requires specific emphasis on learning theory as an additional consideration of successful technology design and implementation (Slota, Young, Choi, & Lai, 2014). Though the existing TPACK framework may implicitly reference learning theory, it is conflated with pedagogy in a way that makes the two seem synonymous. However, instructional approaches like problem-based learning can be implemented and evaluated through very different theoretical worldviews, such as social constructivism, schema-based information processing, and/or situated and distributed cognition. Even if classroom methods share some superficial similarities from paradigm to paradigm, each theory encourages highly divergent methods of assessment, structures student-teacher dialogue very differently, expects a different academic or
motivational outcome, and values a different demonstration of mastery—for instance, schema theory emphasizing prior knowledge, scaffolding, and working memory over storytelling and situated cognition focusing on storytelling to maintain isomorphism with real world action.

To address this shortfall, Slota, Young, Choi, and Lai (2014) developed an expanded version of TPACK that incorporates Learning Theory as an independent structure within the original framework (Figure 2). This modification highlights points of interaction between Technology, Pedagogy, and Content Knowledge in addition to the learning theory that underlies design and innovation.

![Figure 2. Slota, Young, Choi and Lai’s (2014) proposed TPACK-L framework (NOTE: size of overlap does not correspond with relative importance).](image)

Referring to this model throughout the design process, developers can craft tools that are more apt to survive long-term implementation irrespective of the contextual challenges described above. Mastering section O in Figure 2 (i.e., TPCKL), specifically, would facilitate the integration of particular technologies with desired learning theories to form instructionally sound lessons for
given content (e.g., chemistry, history, language arts) that include teacher awareness of the underlying principles and goals for application. In a classroom, this might manifest as pairing a game like *The Elder Scrolls V: Skyrim* with a particular learning objective (e.g., “Students will describe the foundations and practice of feudalism”) in service of generating student-produced videos that catalog similarities and differences between the fictional world of Tamriel and actual medieval Europe—an activity that can be supported using the underlying principles of information processing theory. In a commercial game development setting, it could include an advanced tutorial system that supplies paired examples of complex skill use via a more knowledgeable other (e.g., an in-game character) drawing attention to similarities and differences across gameplay contexts—an appropriate approach under the situated cognition paradigm. Both cases exemplify how a focus on Learning Theory in combination with Technology, Pedagogy, and Content Knowledge may be able to enrich designer, implementer, and user understanding of *how* and *why* a project can and should function in the originator’s target setting. Such a shift in perspective, though subtle, could be the difference between adoption and dismissal by users whose intentions are orthogonal to those of the developer.

*Project TECHNOLOGIA*

While useful in concept, what remains to be understood is the actual effect of TPACK-L design on *in situ* user perceptions and actions. For this reason, the staff of a large, public university Educational Technology graduate program developed a dual alternate reality game (ARG)-roleplaying game (RPG), *Project TECHNOLOGIA*, that would allow TPACK-L evaluation in the context of a game-based learning environment. The game follows the administrators of a fictional space vessel (Appendix A) and requires students (i.e., players) to envision, design, and stabilize a new educational system by providing guidance and support to the community’s leaders. This
grounds the end task—balancing the needs and desires of a K-12 school district—in an educational game (i.e., Technology) built as problem-based instruction (i.e., Pedagogy) for the purposes of teaching educational technology content (i.e., Content Knowledge) under the situated cognition paradigm (i.e., Learning Theory).

Importantly, each mission objective in Project TECHNOLOGIA (e.g., “create a shared vision for technology integration”) directly corresponds to a particular NETS-C International Society for Technology in Education [ISTE] standard for technology coaches (e.g., “create a shared vision for technology integration;” see ISTE, 2014). This ensures a richer contextualization of technology coordinator skills than might be accomplished by simply stating the relevant learning objectives at the start of a lesson about any one skill or set of skills. It also serves to encourage group research, learning through inquiry, and the co-construction solutions to complex, ill-defined problems (Sinnott, 1989; Voss, 1988). While it is not a video game, per se, it relies upon many of the same mechanics and is structured as an online text adventure set within the Blackboard™ Learning Management System. An alternate-reality game (ARG) narrative is used to frame student activities in the broader Master’s degree program, and a roleplaying game (RPG) narrative guides online interactions with non-player characters who introduce the players to increasingly intricate and challenging tasks.

Play itself is rooted in social interactions that take place as students participate in character teams. On a biweekly basis, each team enters the RPG through an imaginary interface, a web browser-based heads-up display (HUD) called the Texto-Spatio-Temporal Transmitter (i.e., TSTT) hosted via Blackboard™ discussion forums. The TSTT houses the game’s immersion sessions (i.e., text-based prompts) and connects them to form a kind of chapter-oriented, media-enhanced story. The operatives (i.e., educational technology Master’s program students) are
encouraged to use external research, various scientific journals, and information taken from their coursework to synthesize and apply information they have learned throughout their time in the Master’s program (i.e., approximately eight months by the time Project TECHNOLOGIA begins).

The “Project TECHNOLOGIA Prompt Trajectory” (Appendix B) highlights how the paired game and narrative objectives are built as a spiral curriculum. All prompts are designed to accommodate “minus,” “neutral,” and “plus” modifications that lead to slightly different versions of the narrative depending on the players’ in-game actions (e.g., helping vs. attacking a non-player character). While groups can shift from one track to the next, they cannot shift across two tracks in one session, and crucially, the differences between the “minus,” “neutral,” and “plus” versions of the narrative are almost entirely cosmetic (e.g., characters responding with different facial features, slightly different phrasing of ideas), used to keep in-game activity in line with overarching program objectives (e.g., “Visioning” as defined by the NETS-C/ISTE standards).

**TPACK-L as a Framework for Design**

Development began with the identification of relevant NETS-C objectives/standards, determination of how story elements could unfold alongside those objectives/standards, and prediction of how the TPACK-L framework might be maintained throughout implementation. This led the developers to utilize mechanics and storytelling elements (e.g., compelling characters representing opposing learning theories) that would simulate the duties of real world educational technology coordinators as closely as possible: problem solving, critically thinking, examining existing literature, generating new questions, working toward realistic shared goals (e.g., “develop a comprehensive technology plan that represents a unified vision for the district”), and collaborating with sometimes-oppositional teachers, administrators, and/or community members. Because the narrative was constructed to follow the same trajectory as the NETS-C/ISTE standards.
standards, each mission inherently involved some task that the players would complete as part of their program coursework and degree requirements regardless of their participation in the game (e.g., creating short presentations about action research, writing reflections).

An unfinished alpha version of *Project TECHNOLOGIA* was offered to a cohort of Educational Technology Master’s degree students one year prior to the game’s full implementation. Student-student and instructor-student interactions suggested that the timeline for content release and quality of online interactions were critical in shaping the overall experience for both instructors and players. This matched the outcomes of a peripherally-related study on drug abuse prevention programs that defined five major measures of program fidelity: Dosage, Adherence, Program Differentiation, Participant Responsiveness, and Quality of Program Delivery (Dusenbury et al., 2003). In particular, Dosage (i.e., frequency and complexity of new prompt episodes) and Quality of Program Delivery (i.e., depth of shared storytelling/interactions) served as strong determinants for student engagement and, taken together, acted as a kind of ‘canary’ for long-term implementation success (Slota, Young, & Travis, 2013). Though *Project TECHNOLOGIA*’s designers originally anticipated that one episode per month would be sufficient for maintaining interest and success, it quickly became clear that students tended to forget major plot points, lose focus on their objective(s), and stop participating when disengaged for more than two weeks and/or receiving only general responses to specific character actions. As a result, the game was revised to feature bi-weekly episodes and additional material (e.g., character-specific expository dialogue) aimed at improving Dosage and Quality of Program Delivery.

Dialogue sampled from the unfinished alpha suggested that the underlying narrative was rich and dynamic enough to engage players but required regular instructor-driven updates to compete with higher-prioritized Master’s program coursework and assignments. As a post-alpha
remedy, the developers targeted areas of the existing narrative that most appealed to alpha participants and/or generated high-quality discussion/debate (e.g., conflicts between characters, arguments, a riot initiated by non-player characters) to increase the number of participation opportunities and fortify comparatively weak plot points. This was intended to expand the narrative to include more “teachable moments” and increase the likelihood that individual player intentions would be more easily traceable throughout play.

For the game’s full release (i.e., the version discussed in this study), assessment was designed to be continuous, embedded, and formative based on the thoughts, behaviors, and interactions of player-controlled characters. After viewing an objective-based prompt posted in the TSTT by an instructional leader (i.e., one of three Master’s program administrators), players would be expected to collaborate with their teams to craft cohesive group responses to non-player character requests. This would allow the instructional leaders to evaluate player familiarity and skill in applying the NETS-C/ISTE standards (e.g., collaboration, visioning) as well as place learners in complex, problem-rich contexts requiring creative thinking, intellectual risk-taking, and self-evaluation of learning. Operative Thought Journals—individualized, private documents hosted in Google Drive—would be used to capture indications of the situated nature of gameplay, including player-generated goals, interactions within and outside of the game, perceptions of invariance between the game environment and real world, and existing/emerging intentions (Appendix C). In sum, the game would supplement the distal and proximal measurement offered by direct instruction and high stakes testing (Hickey & Pellegrino, 2005) by adding rich information obtained through qualitative data collection and analysis.
Game Implementation & Evaluation

Beginning in February 2014, 14 Educational Technology Master’s students at a large, public university were introduced to the full release of Project TECHNOLOGIA (12 female, 2 male; 12 Caucasian, 2 Asian-American, 1 Hispanic; aged 22 to 65 years). All were concurrently employed as practicing educators, and their collective work histories included elementary, secondary, and post-secondary positions in rural, urban, and suburban districts. Their collective enrollment in the Master’s degree program made them an ideal test population given that the design team had earlier face-to-face experience with them as graduate assistants and/or course instructors, the direct supervision of player-game-context interactions would be straightforward to maintain, and the collected data would be representative of the individuals who would most benefit from the outcomes of the study (i.e., educators) (Suter, 2012).

Prior to the first in-game mission, participants were randomly divided into three teams—two groups of five and one of four—each with a separate instructional leader responsible for posting new Project TECHNOLOGIA episodes based on a predetermined schedule, responding with non-player character actions and dialogue as needed, and keeping interactions and progression centered on the NETS-C/ISTE standards. The instructional leaders included two advanced doctoral candidates and one university faculty member, all with specializations in cognition, instruction, and learning technologies and at least four years’ experience working with the overarching Educational Technology Master’s degree program. The players were tasked with controlling individual avatars/characters that could speak, “think” (i.e., give third-person descriptions of avatar thoughts), and act within the story framework. In-game Blackboard™ posts (i.e., character behaviors, thoughts, actions) were used to plan future in-game events (e.g., non-player character dialogue, activities) while the Operative Thought Journals—intended to serve
primarily as analytical tools, not story composition resources—were set aside until game
implementation had ended. The game’s learning objectives and in-game prompts were consistent
across all participant groups, but text details (e.g., non-player character phrasing, diction choices)
varied slightly based on particular team choices (e.g., attacking a non-player character vs. assisting
a non-player character) and instructional leader discretion (i.e., creativity, instructional approach,
and posting frequency).

*Qualitative Analysis*

In spite of the overlap between gaming and traditional learning environments (e.g.,
schools), little is known about why particular games elicit particular thoughts and actions among
particular players (Young et al., 2012; Young, Slota, & Lai, 2012). As such, the investigator elected
to utilize grounded theory analysis as a basis for developing theories about how and to what extent
agent-game-environment interactions emerge as a product of play (Glaser, 1992; 1998), further
arranged using an interpretation theory framework to organize player actions and outcomes across
*Project TECHNOLOGIA*’s 24-week implementation (Potter & Wetherell, 1987; Rennie, 2007;
Thomas, 2003; Young et al., 2012). The game’s emphasis on open, interpersonal dialogic loops
between participants made it possible to preserve the content’s original context (i.e., within a
particular Operative Thought Journal or specific prompt thread) and structure data in easily parsed
and analyzed lots (Cheek, 2004). This allowed for the maintenance and evaluation of important
cues, comments, and player-player feedback present within the original gamespace (e.g., ways to
improve future performance, instances of real or perceived failure, points of critical thinking—any
data that could be extrapolated into broader categories) (Bakhtin, 1981; Foster & Ohta, 2005). The
Operative Thought Journals, written independently of player Blackboard™ posts, were used to
mark individual differences in thinking and learning among participants, informing the analysis of
player perceptions, actions, and intentions emergent in player-player and player-instructor dialogue.

While there is no singularly correct way to administer a grounded theory approach, several steps tend to be consistent across the studies in which it has been applied (e.g., Shaw and Bailey, 2009) in order for the investigator to make scholarly inferences about social interaction based on statement phrasing, the use of particular terms, and the types of responses yielded from particular questions, statements, or arguments (Thompson, 1988). This can help establish the ways in which complex social behaviors (e.g., group learning) manifest in real world contexts (Berger & Luckman, 1967), especially in light of the social construction of meaning, symbols, knowledge, and other abstract concepts (Lave & Wenger, 1991; Vygotsky, 1978). To that end, several assumptions were made prior to qualitative data analysis. Specifically: 1) interaction is favored over outcomes and products; 2) all data must be analyzed by an individual (i.e., the researcher) rather than a machine or piece of software; 3) subjects must be studied in-context, implying the need for triangulation (in this case, understanding student situations and the context for communication); 4) data analysis centers on interpretation and the emergence of meaning; 5) there is inherent orientation toward constructing hypotheses, concepts, and theories from details rather than using details to confirm or deny existing hypotheses, concepts, or theories; 6) all interactions are formed as the result of dialogue and meaning will come as a result of player-player and player-instructor interaction (Bakhtin, 1981; Creswell, 1994; Hathaway, 1995; Merriam, 1988). In sum, this allowed me to place emphasis on how and why participating players may have developed particular goals, co-constructed particular solutions, and/or adopted particular strategies to overcome challenges in Project TECHNOLOGIA—a process that afforded richer interpretation
than would have been possible using a predominantly quantitative evaluation of student progression toward a particular dependent variable (e.g., achievement, motivation).

Data analysis took place as a nine-step process (Table 1) beginning with the import of all 274 Blackboard™ discussion posts (Table 2) and 14 Operative Thought Journals into QSR NVivo 10 (approximately 44,400 words excluding the pre-written, episodic narrative prompts). Given the contextual differences between the two (i.e., co-constructed in-game vs. individual/internal, respectively), the investigator initially approached them as separate resources in order to inductively identify mutually exclusive common word, phrase, and concept usages (e.g., “collaboration,” “goal,” “I would like to…”). Due to the sheer volume of common word, phrase, and concept usages embedded in both discussion board posts and Operative Thoughts Journals, the investigator further parsed each player-generated paragraph into composite idea units comprised of individual comments, statements, and/or questions. These idea units were occasionally shorter than a full sentence but never more than three sentences in length. Importantly, they were analyzed in the presence of the preceding and following idea units to minimize the loss of vital, context-dependent information (e.g., author tone, intention).

The investigator tracked commonalities between idea units throughout the reading process via open coding and further refined them into individual nodes using QSR NVivo 10’s coding toolkit (Glaser, 1992; 1998). This resulted in 11 unique nodes across the 14 Operative Thought Journals (Appendix D) and 11 across the Blackboard™ discussion posts (Appendix E). These nodes were then used to guide the axial coding of all collected data as well as the identification of any categorical themes emergent across both sources (i.e., Operative Thought Journals examined alongside corresponding in-game dialogue) (Appendix F) (Strauss & Corbin, 1990; 1998). This set a foundation for unpacking how and why particular individuals interacted with one another and
the game in particular ways, feeding back into the investigator’s goal of determining whether and to what extent particular factors might influence agent-environment interactions in the game context, what role contemporary learning theories might serve in game design, and how design parameters could be improved among commercial and educational game developers.

Table 1. Stepwise approach to grounded theory analysis of Project TECHNOLOGIA data.

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Import participant data from Blackboard™ (i.e., in-game posts) and GoogleDocs (i.e., Operative Thought Journals) into QSR NVivo 10</td>
</tr>
<tr>
<td>2.</td>
<td>Scrub identifying information (e.g., names, school districts) from imported data, assigning a randomly generated five-digit identification number to each participant</td>
</tr>
<tr>
<td>3.</td>
<td>Read all discussion posts and Operative Thought Journals within their exclusive contexts (i.e., as separate datasets)</td>
</tr>
<tr>
<td>4.</td>
<td>Identify common word, phrase, and concept usage within each dataset via inductive open coding</td>
</tr>
<tr>
<td>5.</td>
<td>Record trends in word, phrase, and concept usage as unique nodes within QSR NVivo 10</td>
</tr>
<tr>
<td>6.</td>
<td>Use established nodes to review and axially code data across both datasets, first individually and then taken as one</td>
</tr>
<tr>
<td>7.</td>
<td>Record emergent categorical themes as identified through the axial coding process</td>
</tr>
<tr>
<td>8.</td>
<td>Establish recommendations for future research based on emergent categorical themes</td>
</tr>
<tr>
<td>9.</td>
<td>Present findings to participants in service to data/analysis triangulation</td>
</tr>
</tbody>
</table>

Table 2. Number of Blackboard™ Posts Across Project TECHNOLOGIA episodes.³

<table>
<thead>
<tr>
<th>Group</th>
<th>1.1</th>
<th>1.2</th>
<th>1.3</th>
<th>2.1</th>
<th>2.2</th>
<th>2.3</th>
<th>3.1</th>
<th>3.2</th>
<th>3.3</th>
<th>4.1</th>
<th>4.2</th>
<th>4.3</th>
<th>5.1</th>
<th>5.2</th>
<th>5.3</th>
<th>6.0</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1</td>
<td>6</td>
<td>5</td>
<td>8</td>
<td>6</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>5</td>
<td>5</td>
<td>74</td>
</tr>
<tr>
<td>Group 2</td>
<td>6</td>
<td>9</td>
<td>19</td>
<td>12</td>
<td>8</td>
<td>5</td>
<td>9</td>
<td>6</td>
<td>4</td>
<td>2</td>
<td>7</td>
<td>7</td>
<td>6</td>
<td>8</td>
<td>8</td>
<td>6</td>
<td>122</td>
</tr>
<tr>
<td>Group 3</td>
<td>5</td>
<td>7</td>
<td>3</td>
<td>9</td>
<td>3</td>
<td>11</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>9</td>
<td>3</td>
<td>4</td>
<td>2</td>
<td>7</td>
<td>7</td>
<td>4</td>
<td>78</td>
</tr>
<tr>
<td>Total</td>
<td>17</td>
<td>21</td>
<td>30</td>
<td>27</td>
<td>15</td>
<td>20</td>
<td>14</td>
<td>14</td>
<td>9</td>
<td>14</td>
<td>14</td>
<td>13</td>
<td>11</td>
<td>20</td>
<td>24</td>
<td>15</td>
<td>274</td>
</tr>
</tbody>
</table>

Upon completion of the initial analysis, a second researcher—the university faculty member assisting as a Project TECHNOLOGIA instructional leader—reviewed approximately 20% of the total data using the coding scheme generated through the primary investigator’s open and axial coding. This independent evaluation of code consistency, utility, and overall trustworthiness (i.e., peer debrief; see Morse, Barrett, Mayan, Olson, and Spiers, 2002; Spillet, 2003) yielded roughly 74% initial overlap with the primary investigator’s original code

³ It is worth noting that while Groups 1 and 2 produced nearly the same number of discussion posts throughout Project TECHNOLOGIA, Group 3 produced approximately 50% more. All groups were comprised of teachers with similar experiences, workloads, and external responsibilities, and post content between the three groups was roughly similar in quality. This suggests that there may have been a quirk with Group 3 participation or an indirect motivating effect of Group 3’s instructional leader—the university faculty member. This question went unanswered during triangulation and debriefing but will be addressed in future implementations of the game.
assignments. Misalignments between the two were used to re-assess the findings and catalog areas where code clarity, precision, and specificity needed to be improved. Though the process resulted in minor modifications to a small number of code definitions, no codes were judged in need of elimination or replacement. In combination with participant member checking at the investigation’s conclusion, data collection, parsing, and interpretation were determined to be qualitatively reliable within the scope of the study.

Quantitative Analysis

The study’s limited sample size (n=14) and lack of a standardized benchmark exam made it difficult to take a principally quantitative approach toward examining player learning in Project TECHNOLOGIA. A conservative estimate calculated via GPower 3.0 suggested that 200-300 participants would be necessary to achieve the requisite statistical power for assessing game effectiveness at improving player knowledge and application of the NETS-C/ISTE standards (i.e., running experimental and comparison groups to compare achievement gains). As an alternative, the researcher sought to use student grades, evaluations, and assignment completion rates to triangulate individual differences between player successes and failures in the gamespace and broader Master’s degree program. However, because all participants finished the program with a grade point average (GPA) at or very near 4.0 with zero missed assignments, quantitative e-portfolio and ceiling effects rendered the data unanalyzable—there would be no correlation between program-level achievement and the knowledge, attitudes, or behaviors that emerged as a product of gameplay if all players achieved roughly equal GPAs. This resulted in a focus on solely qualitative analyses that could be used to frame future quantitative investigations (e.g., studies of player achievement, motivation, goal adoption).
Results & Implications

The section below informs the two questions posed at the beginning of this study by cataloguing the effects of Project TECHNOLOGIA as a TPACK-L-designed game in the context of participant thoughts and actions throughout implementation. The results are divided into categories emergent from the grounded theory analysis and organized around central themes relating to the game’s design, application, and structure. Ideally, this will help organize a continuing program of study that will advance game design parameters as well as establish contemporary learning theory as a valuable component of commercial and educational game development.

Interface, Narrative, & Fostering Success

Wouters et al.’s (2013) meta-analysis of educational gaming concluded that photorealistic graphics were not a critical contributor to the success or long-term playability of games utilized in academic settings. This suggests that other factors (e.g., controls, mechanics) likely have a greater impact on whether or not players engage with a particular game than high-fidelity visual effects. Participant thoughts and dialogue throughout Project TECHNOLOGIA appear to support this conclusion, indicating that player satisfaction is most closely associated with peer-to-peer discussion, collaborative problem solving, and creative co-storytelling. However, certain graphical elements—particularly those related to the user interface—may have a nontrivial effect on some users’ experiences that is worth noting during the design process, especially if the interface might negatively influence the various interactions listed above.

Because all Project TECHNOLOGIA participants had at least six months of experience using Blackboard™ discussion forums, the investigator believed that the learning management system’s use as part of gameplay would not be problematic for reading and writing among
players—after all, it is explicitly designed to facilitate discussions like those necessary for Project TECHNOLOGIA to unfold. Yet, the Blackboard™ forums proved to present difficulty for many players who indicated that the site’s design failed to emulate a co-developed storybook, instead muddying player-player and player-instructor communication:

Tonya (Thought Journal [TJ] Episode Number [1.1]): “I wish there was a way to go back in the thread and put my into in the correct place, seeing as I was a day late to the party this week.”

Shawna (TJ 1.2): “I’m still finding the interface confusing- like the message to check back in with my group- is that the storyline?”

Bella (TJ 2.3): “I’m having a hard time following the story - going back to reread all of the episodes and prompts gets overwhelming. As such, I am still having a difficult time formulating a logical and informed response”

Nadine (TJ 3.1): “If you don’t log on for a few days, it’s hard to backtrack and read all the responses since its a “reply” button system.”

This may have contributed to a recurring problem early on when players struggled to understand how they should participate (e.g., “Why do we need to write in the third person?” Marsha, TJ 1.1) and occasionally described “missing” how the game and instruction components corresponded (e.g., “I think that the story and concept behind this project is interesting, however, standing alone it’s missing the component of using it as a teaching tool,” Sue, TJ 1.2). In response, some suggested that the game’s next iteration include a small number of images to simplify and/or reduce the reliance on text:

Pamela (TJ 1.2): “The language and the script is hard to read and follow. I wish there was a visual world that there were cartoon figures”

Walter (TJ 1.1): “Without seeing other character faces, it is a bit challenging to interact them.”

And two participants proposed that the designers choose an alternative platform that might better represent the game’s intended novel-like structure:
**Sue (TJ 0.0):** “Reflecting back on the virtual world created in Edmodo, I found the way the presenter embedded Latin within his narrative helpful.”

**Marsha (TJ 1.1):** “Didn’t we use Edmodo to conduct discussion anonymously? Why aren’t we using that again?”

In the end, a small number of players felt they could not fully participate in the game, stating that “getting into it” (Tonya, TJ 1.2) was much more difficult than it should have been. However, these individuals were offset by others who expressed such fondness for science fiction and/or fantasy that they were willing to overlook Blackboard™’s deficits in order to engage with the narrative in a deeply personal way:

**Walter (TJ 0.0):** “Project Technologia has some analogies to ‘The Matrix’ (movie). I love the Matrix!”

**Becky (TJ 2.1):** “I can’t help it if I’m the only one whose father read them the Lord of the Rings trilogy when she was four and never missed an episode of the X-Files in college.”

**Shawna (TJ 1.2):** “I was sorely tempted to punch Bif in the face, just to see what would happen… you planted a seed… and Bif for no other reason that all I can think of is “hello, McFLY!!!”)”

Becky in particular believed that having prior experience with science fiction made gameplay more approachable and satisfying than it otherwise might have been:

**Becky (Project TECHNOLOGIA [PT] Episode Number [6.0]):** “Research a little on gaming and role play. Go back and skim your Douglas Adams, Orson Scott Card, Ray Bradbury, Margaret Atwood, Tolkien, and your Potter books if you have time. (Everybody has a set of these, right?). Re-watch your Firefly DVDS and shake your head that the show was canceled… Don’t assume everyone is going to hate it. Just because someone doesn’t look like a Trekkie doesn’t mean they don’t hide it well. Too much “hating” might hurt their feelings.”

Comments like these suggest that players who approached Project TECHNOLOGIA with greater open-mindedness about the underlying genre and game structure also tended to experience the most fulfillment as a by-product of gameplay. In addition, given the connection between transfer
and pleasant frustration (i.e., moments where challenges exist within but on the outer edge of competency), it seems plausible that individuals who particularly enjoyed the genre, story, and game format might also have been better prepared to perceive invariance between the narrative and similar real world situations it was designed to emulate.

Further studies of individual preferences for agent-content interaction and the influence of particular narrative elements on goal adoption (e.g., character development, theme, genre) would provide much needed data about these potential relationships. In that vein, learning scientists might consider targeting how and why individual story readers/participants decide which stories, games, and information to engage with through experimentation with multiple versions of the same narrative (e.g., video game, novel, poem, bullet-pointed list). Participants could be asked to interact with a preferred piece of media, note their intentions prior to, during, and after engagement, and then provide qualitative and quantitative feedback about the overall experience. This would help ground additional experimentation with particular mechanics and story devices to generate innovative strategies for engaging learners—as students or players—with domain content.

Learning Theory as Content & Mechanic

Contemporary learning theory served two major purposes in Project TECHNOLOGIA: 1) as program content (i.e., information players would need to utilize post-graduation as district technology coordinators), and 2) as the basis for the game’s design, mechanics, and underlying pedagogy. With respect to the former, each player character came equipped with a pre-existing theoretical worldview intended to shape participant choices throughout play—an embedded learning theory mechanic. For instance, students who were randomly assigned the “Will Alexander” avatar were encouraged to describe their in-game thoughts, perspectives, and actions through the lens of social learning theory. Each of the five avatars—Will Alexander (social
learning theory), Diego Rivera (situated cognition), Adan Nahas (behaviorism), Lienne Tanaka (constructionism), and Aliyah Mills (schema theory)—were represented by one individual in each of the three player groups. Consequently, all participants controlled only one character with one assigned learning theory but were exposed to the other learning theories (i.e., those they were not assigned) by interacting with their peers.

Organizing gameplay around this mechanic led to two findings. First, the worldview mechanic itself was not sufficiently scaffolded by the instructors, and players experienced difficulty maintaining an assigned worldview that was not their own. This resulted in several individuals halting the incorporation their assigned theories as the story progressed. Several lamented that adhering to the worldview impeded their ability to play out their characters as they wished, and its forced inclusion seemed to inhibit communication more than it helped to enrich storytelling:

*Gretchen (TJ 0.0)*: “I’m not sure if I include too much information or if I don’t include enough.”

*Dani (TJ 0.0)*: “I’m feeling a little confused about how to transfer the Aliyah description into a character…My focus for my character now is on memory. I plan to be skeptical and worried when encountering new situations that don’t match my existing memories.”

*Bella (TJ 1.2)*: “I really struggled with this prompt and hence didn’t respond in time. I think my biggest issue is that I am not comfortable enough with Adan’s worldview (behaviorism) to take a stance and support my claims using the worldview”

*Shawna (TJ 1.2)*: “I try to argue the points that I believe through the behaviorist approach but I do find it hard to look at everything through one lens…”

This is not to say that the players did not understand the theories they were assigned. Rather, they were not prepared to apply this knowledge and, in context, discuss the ways a behaviorist, schema theorist, situated cognitivist, constructionist, or social learning theorist might react to a specific
activity, idea, or event (e.g., implementing a 1:1 tablet program). All players demonstrated some form of superficial worldview knowledge (e.g., “Will Alexander drifts toward the statue as with his social learning background he looks to the tall man for help and support,” Mandy, PT 0.0), but those demonstrations ultimately did little to further problem solving with the assigned theory.

Interestingly, many players did incorporate personal perspectives of thinking and learning into their responses despite reluctance to utilize the worldviews assigned to them. This included both tacit nods to theory-driven pedagogical techniques (e.g., “we and your expert people together can show your people how to use these technologies in various ways and create the community of practice so that your people can get more sense of the value of these technologies,” Greg, PT 2.2) as well as direct references to the worldviews they fall back on as individual in-service teachers (e.g., “Since I am a strong proponent of authentic learning experiences [pedagogy], I would prefer to identify ways to link technology with content and real-life [without regard to learning theory]. This would mean establishing important concepts in each content area and figuring how to integrate technology in a meaningful way that enhances learning,” Nadine, PT 2.1). Such contributions support the notion that some types of in-game dialogue might induce transfer between game and in situ contexts (e.g., “I like that we’re finally getting to the “rebuilding phase” of the educational system…It’s a good link between putting theory into practice.,” Nadine, TJ 1.1).

This is encouraging insofar as it suggests that specific social and/or textual cues might be useful for leveraging goal adoption in game-based learning environments. Determining exactly which cues are most and least effective could be accomplished via player dialogue analysis using games like Project TECHNOLOGIA or Dungeons & Dragons, and findings from that work could lead to more comprehensive theories about why information from some games seems to be more transferable than information from others (e.g., Annetta, Minogue, Holmes, and Cheng, 2009;
Given the immediate need for improved test preparation tools, there would likely be immediate benefits within the education community. Though the same might not be said for commercial design, it seems probable that any positive outcomes would at least inform employee training techniques, within-company professional development procedures, and the creation of more efficient game marketing through peripheral alternate reality tools.

TPACK-L in Action

As noted in the previous section, learning theory served as not only a portion of Project TECHNOLOGIA’s content and embedded mechanics but also the basis for the game’s design, associated pedagogy, and analysis. Parsing how this supported and/or failed to support development is complicated, but in comparing the more contemporary situated cognition approach with extant behaviorist gamification (e.g., Ke, 2008a; 2008b; Young et al., 2012; Young, Slota, and Lai, 2012), it seems likely that a more nuanced, learning theory-supported design process may have benefits for both educators and commercial designers.

Educational and commercial designers have highly divergent perspectives on how learning theory might fit into the development process (D. Norton, personal communication, July 8, 2014; Proctor, 2013). Many of the psychological “tricks” described in design texts like Schell’s (2008) The Art of Game Design: A Book of Lenses emphasize reward structures adapted from behaviorism—implied to influence factors like interest and fun—because it makes for reasonably entertaining gameplay (see also Brathwaite and Schreiber, 2008; Fullerton, 2008; Proctor, 2008). By contrast, learning scientists like Gee (2007; 2013) have urged the avoidance of variables that are neither empirically helpful nor isomorphic with learning or play objectives (e.g., fun), arguing that games should instead focus on social collaboration, modeling, and the complex agent-
environment interactions that make rich learning contexts valuable. The two perspectives have little in common, and because of their orthogonal goals (i.e., profitability vs. instruction/transfer), it may seem as if reconciling them is not worth the resource commitment.

Yet, researchers like Young et al. (2012) see potential in hybrid commercial-educational design partnerships:

We believe that commercial gaming companies and educational researchers could mutually benefit by bringing academic content into the fictitious worlds originally created without educational content objectives in mind. Rather than attempting to reframe academic objectives in their own immersive universes, educative minigames could be added to larger game worlds to meet both the learning objectives of a subject area course and the narrative of the game…This innovation would invariably provide additional learning opportunities as players begin to share their knowledge with one another and participate in cognitive apprenticeships between accomplished [players] and novices… (pp. 82).

This is a tough sell among commercial developers who view educational goals as a tertiary priority falling far behind financial viability and various game-related concepts like fun (C. Johnson, personal communication, March 26, 2014). However, because TPACK-L is specifically intended to accommodate complex technology, content, instruction, and theory integration (Slota, Young, Choi, & Lai, 2014), fusing it with design models traditionally associated with iterative game development (e.g., ADDIE, Scrum) might serve as a way to non-invasively bridge and strengthen both commercial and educational game planning, development, and implementation.

For example, because player responses to Project TECHNOLOGIA’s worldview mechanic indicated that it was an impediment to gameplay, the developers were able to evaluate and act upon the problem by returning to the game’s TPACK-L foundation. Rather than scrapping the mechanic outright or re-conducting a full needs analysis, they created an empirically-supported, collaborative, experiential tool structured around helping users apply what they had learned (CTGV, 1993). This expanded on existing design models like ADDIE by combining empirically-
testable perspectives of thinking and learning with information drawn from the initial needs analysis (i.e., how and why particular users might and should approach the given tool in a particular way) (Morrison, 2010; Young, 2004). Eventually, this led to the construction of a new training module (i.e., Secure Mission Agent Recruit Training and Specialization School) that would unfold as a series of cascading episodes beginning with relatively simplistic content-theory integration (e.g., ClassDojo and behaviorism) and ending with more complicated content-theory integration (e.g., massively open online course videos and situated cognition) (Bruner, 1966; Slota, Young, Choi, & Lai, 2014) in order to provide students with an opportunity to practice transferring the knowledge of learning theory to technology integration situations.

Although the new module has not yet been tested, Project TECHNOLOGIA’s particular grounding in TPACK-L appears to have yielded four distinct affordances for game design: 1) the ability to examine direct effects on player knowledge and player-game-context interaction as governed by a particular learning theory; 2) expansion and improvement of the game to make it more engaging among members of its intended audience; 3) the possible induction of player goals via guided in-game interaction (i.e., “intentional springs,” see Shaw, Kadar, Sim, and Repperger, 1992); and 4) the use of gameplay data to inform cognitive science research about the nature of human thinking and learning. If a similar approach were to be used in the context of a commercial game like League of Legends or World of Warcraft, it could mean the innovation of new game mechanics (e.g., tutorial tools, player-governed design mechanisms) that would facilitate the study of how and why particular types of players play these games as well as the reduction of toxic social behaviors that detract from gameplay and community well-being (e.g., Lin, 2013).

Several Project TECHNOLOGIA participant comments offered insight into how an ADDIE-TPACK-L design process might be advantageous as a matter of long-term game viability:
Greg (TJ 0.0): “working and talking with the other avatars as a group help me understand not only the story but the way of game play, and of course provide me with the high level of fidelity that I’m really existing in that world and working with them.”

Becky (TJ 2.3): “I have decided that with one class I am going to give them an assignment a day that in some way involves their cell phones.”

Sue (TJ 1.2): “The interplay between characters while also using this new information, let me see how it could be applied in a similar context.”

Nadine (TJ 3.2): “The crowd is getting very animated about changing the educational system. This is probably an accurate animation of how real people would act if there were BIG changes to the education field.”

Here, social learning, transfer, and collaborative problem solving are described as integral parts of gameplay which, for a game designed to help learners become better at particular real world skills, is reassuring. It would be premature to read too far into this without additional empirical follow-up (e.g., “What elements of gameplay did you most and least value?” “Did the experience provide any value for team-building, informing your instruction, and/or helping you better understand the role of a technology coordinator?” “Would you play again?”), but much of the players’ self-reported end-game feedback suggests that using TPACK-L—and, by extension, situated cognition—as the driving design framework did in fact help support the game’s instructional goals (i.e., fulfilling the NETS-C standards for visioning, etc.):

Winnie (PT 6.0): “Project Technologica forces you to put all of the skills you have learned from the [graduate] program into action... True advice to consider when entering into this strange world is to remember to thoroughly engage in the activity; like a true technology integration specialist should... Consider all of the opinions and challenges presented to you, and harness the techniques you have learned in your [graduate] courses as a framework for how to guide the RA population.”

Tonya (PT 6.0): “…Project Technologia sets out to accomplish what every school district across the nation hopes to deliver to their students: a positive learning environment that addresses the diverse needs of all learners through collaborated efforts and implementation of strong pedagogies. While the dramatic format of the ‘course’ may not be ideal to all participants, everyone can appreciate the objectives of the missions and their connections to our current careers. There will always be
coworkers, parents, or students that are oppositional (who doesn’t know a Rheegan?), but by collaborating with peers and sharing different ideologies, there are solutions for every problem...My advice to any noob who is about to begin this journey is to think of it as a sort of digital apprenticeship. Do not get caught up in the drama and the (sorry) at times annoyance of having to take on an alter ego, instead look at Project technologies as an opportunity to showcase all of the skills and content learned throughout the [graduate] program.”

Dani (PT 6.0): “...Be decisive: The success of Project TECHNOLOGIA (and success in a technology role) hinges on the ability to make decisions after assessing needs, considering different perspectives, and weighing the pros and cons of each perspective. Once this is done, a decision must be made in terms of what direction to head, whether it’s deciding on a specific technology, an instructional method, or leadership for a group. Indecision is a guarantee that nothing will get done...Realize that Project TECHNOLOGIA has a direct connection to the [graduate] coursework. The situations presented for the avatar all have a connection to the role of a real-life tech coordinator...”

In answer to the second research question posed at the beginning of this study (i.e., “How can and should contemporary theories of human thinking and learning factor into game design and implementation?”), it appears that developers could benefit from the pursuit and refinement of TPACK-L-driven development procedures. Ideally, this would provide new data about whether or not TPACK-L design is viable for all learning theories (e.g., schema theory, behaviorism, situated cognition, social learning theory) and to what extent it can make educational and commercial game design more efficient, economically sound, and effective in the long term. Success will require absolute commitment to the theories underpinning design as well as the careful alignment of game and instructional goals, but the potential benefits associated with enhancing design this way—including improved social interaction, community building, tutorial design, and more—should counterbalance the time and resources needed to wisely integrate learning theory.

Limits of Interpretation

As with any qualitative study, data collection and analysis throughout Project TECHNOLOGIA was subject to bias in individual participant and investigator intentions,
preconceptions, and interpretations. In their review of why novel approaches to technology implementation fail, Slota, Young, and Travis (2013) affirmed that education research is often plagued with “situations where participating educators “do it for the researcher(s)” or for the status of being part of the research team, or the resources involved in a grant project” (pp. 42). Given the nature of the Master’s program from which participants were recruited, it is possible that some could have misrepresented their own judgments, ideas, or comments believing that they would help or earn favor with the investigator or program administrators. Likewise, if a particular participant or group of participants had some intention to willfully misinform the investigator or otherwise hurt the project, they could have entirely misstated their thoughts within the Operative Thought Journal.

It is equally plausible that the concepts, feelings, and thoughts associated with play were simply too complicated to accurately capture in brief, self-reported text posts. While Norris (2007) argued that this does not inherently invalidate qualitative research, it does pose an on-going problem for researchers seeking to equate ethnographies, grounded theory studies, or other qualitative work with more traditional quantitative approaches. At issue is the fact that humans are multifaceted, possessing attitudes and behaviors that change moment-to-moment as a function of environmental context, prior experience, and emerging goals. Ideally, triangulation with participants, peer review, and repeat study can minimize bias, but until statistical models and data technologies offer better model building than the standard normal curve, granular assessment of participant thought and action will be limited to qualitative investigation at the individual level.

To minimize bias, the investigator refrained from teaching or grading participants throughout the game-based program’s duration (i.e., the period during which the game/program primarily took place), and participants were not required to contribute to the game as part of their
coursework or the Master’s program plan of study. They received a face-to-face debriefing session as part of their final week of the Master’s educational technology program, and at that point, the investigator listened and responded to questions, concerns, and feedback that could inform the analytical process. Additionally, the investigator shared his findings with the participants to ensure that the analysis accurately reflected their individual intentions, goals, and understandings of what was written and transpired within each team. The open and axial coding process was conducted under the advisement of a second researcher and verified through a combination of re-coding and peer debriefing once the initial nodes were deconstructed for the purposes of cataloguing thematic outcomes across the data.

Due to limited sample size (n=14), unequal distribution of participant sex, non-random sampling, and the qualitative approach to data collection and analysis, the findings from this study only reflect the knowledge, attitudes, and behaviors of those who chose to participate. The results are not generalizable to a larger population and should not be used to draw conclusions about other educational technology programs, graduate students, games, or learners as a whole. However, the study does provide a potential starting point for future research aimed at examining preferences for media consumption, optimal design methodologies, and the role of learning theory as part of the game development process. Should this occur, it will be important to establish individual differences between the participants featured in this study and those of any subsequent investigations.

Conclusions

This study of game mechanics, content, and design has provided valuable information about ways in which learning theory might inform future educational and commercial game development. Feedback regarding Project TECHNOLOGIA’s implementation indicates that
although there are still design flaws that must be addressed, the theoretical foundation on which the game is built has afforded opportunities for players to engage in activities that reflect the roles they will fill upon completion of the educational technology graduate program. Additionally, given the outcomes associated with TPACK-L’s utilization as framework for design, there is reason to believe that pursuing a dual ADDIE-TPACK-L approach to game development could support improved design procedures and future partnerships between the educational and commercial gaming communities.

These results are a first step toward better defining methodological approaches for studying educational gaming in K-12 and university learning environments. There are still many questions about the ways in which games influence complex events like transfer and goal adoption, but understanding player intentionality, interaction, and learning outcomes may facilitate advancement in targeting academic and real world perception, action, and intentionality through play. Without taking these factors into consideration, “gamified” game-based learning may only encourage students to develop isolated, unrelated skills under the vague hope they will transfer into fluent, on-the-job performance at a later time. The story of richly authentic education can only advance if learning scientists expand the scope of their investigation beyond the behaviorist theories of the 1970s to include social, cognitive, and situated learning. With any luck, getting the process underway with TPACK-L will finally help the education community locate the right castle in their on-going effort to rescue an ever-elusive game-based learning princess.
References


## APPENDIX A

### Summary of Project TECHNOLOGIA Narrative

<table>
<thead>
<tr>
<th>Week</th>
<th>Number</th>
<th>Episode Title</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.0</td>
<td>Welcome to Project TECHNOLOGIA (Tutorial)</td>
<td>The operatives are presented with their first opportunity to engage one another in dialogue using the TSTT. They are asked to become their respective TSTT avatars and describe (in the 3rd person) the game interactions of their characters.</td>
</tr>
<tr>
<td>3</td>
<td>1.1</td>
<td>Starting a New Life on Remmlar Array</td>
<td>The operatives are ported into a derelict alien space station (i.e., Remmlar Array) in the distant future (i.e., 2247CE). Here, they engage with the narrative’s major characters: Duncan Matthau, Rheegan Hamilton, and Biff Wallace, leaders of the station’s Administrative Council.</td>
</tr>
<tr>
<td>4</td>
<td>1.2</td>
<td>Many Meetings</td>
<td>Duncan, Rheegan, and Biff advocate for their personal philosophies of education (i.e., democratization, economic equalization, social competency). They also describe their role as leaders on Remmlar Array. The operatives confer with one another about how these philosophies align with their given Learning Theory worldviews and argue for using their respective worldviews as the basis for the colony’s shared educational vision.</td>
</tr>
<tr>
<td>5</td>
<td>1.3</td>
<td>The First Step</td>
<td>The operatives are pushed to agree on a single administrative philosophy (i.e., democratization, economic equalization, social competency) to guide the development of an initial technology integration framework. They must provide a compelling argument for how their respective Learning Theory worldviews can support the adopted framework.</td>
</tr>
<tr>
<td>7</td>
<td>2.1</td>
<td>New Beginnings</td>
<td>Duncan, Rheegan, and Biff describe the state of the colony’s social, economic, and cultural structures, specifically noting deficiencies in formal reading programs used to teach literacy in the context of advanced communication devices. The operatives co-develop a definition for “literacy” before moving forward.</td>
</tr>
<tr>
<td>9</td>
<td>2.2</td>
<td>From Scratch</td>
<td>Duncan, Biff, and Rheegan ask the operatives to help with the design of a formal literacy program. They are presented with a variety of communication tools (e.g., tablets, personal communicators) that are made available for distribution across the space station.</td>
</tr>
<tr>
<td>11</td>
<td>2.3</td>
<td>Ascent</td>
<td>The operatives are asked to plan and guide implementation and professional development for the new literacy program. Initial distribution of devices among the colonists begins.</td>
</tr>
<tr>
<td>13</td>
<td>3.1</td>
<td>Sparking the Fuse</td>
<td>As the literacy program goes into effect, it becomes apparent that Duncan, Rheegan, and Biff have distinctly different goals for the colony’s long-term technology plan. Duncan and Rheegan, in particular, are so enraged that they nearly break into a public brawl.</td>
</tr>
<tr>
<td>15</td>
<td>3.2</td>
<td>Shouldering the Blame</td>
<td>The Administrative Council members temporarily set aside their differences upon realizing the broader population’s frustration. Remmlar Array’s colonists feel that their voices have been minimized during the development of the long-term technology plan, causing it to teeter on the edge of collapse. The operatives are given a chance to address the colonists’ concerns.</td>
</tr>
</tbody>
</table>
| 17 | 3.3 | Fixer Upper | A. The citizens of Remmlar Array call for a vote of no confidence in Duncan, Biff, and Rheegan. The operatives are forced to quickly enact a comprehensive technology plan that will quell anxiety or else risk pushing Remmlar Array into total chaos.  
B. The citizens of Remmlar Array are temporarily appeased and begin to share their input. However, the operatives are placed under increased scrutiny and pressured to act quickly on the rollout of their comprehensive technology plan. |
| 19 | 4.1 | Herding Cats | A. Duncan shuffles the operatives to a corner of the hallway and candidly states the problem: they need to refine their ideas to acknowledge the needs, intentions, and goals of the target population (i.e., the citizens of Remmlar Array). The population’s hysteria cannot be quelled until the group agrees on a path forward.  
B. The operatives begin gathering user input, and three types of users begin to emerge: 1) Technology Innovators who invest time and effort into designing effective ways to use the devices to learn; 2) Vocal Complainers who instantly reject any idea of change and lament the administration’s attempts to integrate technology; and 3) the Confused who are inclined to use available technology but have no skills or time to make learning about the technologies a priority in their busy lives. Duncan, Biff, and Rheegan ask the operatives to help nudge the population toward innovation and away from the creation of more luddites. |
<table>
<thead>
<tr>
<th>Page</th>
<th>Section</th>
<th>Subsection</th>
<th>Text</th>
</tr>
</thead>
<tbody>
<tr>
<td>21</td>
<td>4.2</td>
<td>Different Strokes</td>
<td>At the conclusion of the focus group session, citizens approach the operatives to discuss individual concerns. Though different educational settings require different approaches to technology (e.g., assistive technologies, specialized computer programming environments, engineering tools like CAD, scientific research instruments), complaints of inequity and bias emerge as not everyone receives “the exact same thing or something of equal value.” Rheegan’s frustration is apparent, and she disappears from the conference room.</td>
</tr>
<tr>
<td>23</td>
<td>4.3</td>
<td>There’s One in Every Crowd</td>
<td>As Biff and Duncan address the citizens’ equity concerns, Biff discovers a significant data breach in the Remmlar Array computer system. Issues of storage, security, management (e.g., deleting files), spoofing, viruses, phishing, identity theft, and cybercrime/cyberbullying rock the operatives’ efforts to infuse technology into instruction. Several previously-supportive citizens react by backpedaling and suggest that the move to technology was too fast. Others advocate the imposition of accountability measures on technology applications and demand strict oversight and control of usage.</td>
</tr>
<tr>
<td>24</td>
<td>5.1</td>
<td>Beginning of the End</td>
<td>Despite Biff’s work to patch the data breach and Duncan’s dialogue with skeptical Remmlar Array colonists, several individuals speak out as more wary of technology than ever before. However, there remain a small number of exemplary innovators who have chosen to follow the guidance of a gifted adopter named Isuru. These individuals tell the operatives they are willing to try the technologies and work out the kinks. Unfortunately, the comparatively cranky Bertha has convinced her friends to oppose Isuru and the Administrative Council, becoming increasingly vocal and demanding a halt to technology adoption. The majority of citizens, represented by Lindsi, feel trapped somewhere in the middle of the debate and are weary of the ceaseless arguing. They are demoralized and have lost sight of the Administrative Council’s original goal. Rheegan returns without saying where she’s been but makes it clear that she disagrees with Duncan’s plan to publicly share the operatives’ co-written speech about the necessity of widespread technology adoption.</td>
</tr>
<tr>
<td>24</td>
<td>5.2</td>
<td>Devil in the Details</td>
<td>Though many of the colonists now see the value of adopting technology, they are beginning to use it in disparate ways, partially based on which technologies they initially received and partially based on prior assumptions about how people think and learn (e.g., some individuals push for case-based, some gamification, and some direct instruction, online learning, and/or MOOCs). The operatives are tasked with infiltrating each faction to consult individuals about the wise integration of technology within their specific content areas (i.e., TPACK-L).</td>
</tr>
<tr>
<td>24</td>
<td>5.3</td>
<td><em>Lost and Found</em></td>
<td></td>
</tr>
<tr>
<td>----</td>
<td>-----</td>
<td>-----------------</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>The colonists begin putting the operatives’ TPACK-L consultation to use, but there are creeping Fatal Mutations to the Administrative Council’s broad implementation goals due to lacking teacher (i.e., implementer) understanding of learning theory. Rather than innovating with technology, there is widespread teaching about technology—a distraction from the core curricular content. Duncan asks the operatives to model desired outcomes by running professional development workshops that highlight wise learning theory, technology, content, and pedagogy integration.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>24</th>
<th>6.0</th>
<th><em>When Worlds Collide</em></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>The root of Rheegan’s earlier disappearance and the data security breach is made obvious as a rift opens in the TSTT generation room. A second Rheegan, successful at implementing her vision for schools as career training/test centers, has been summoned to help push the original Rheegan’s economic equalization vision for Remmlar Array. However, reckless abuse of the TSTT has caused a tear in the space-time continuum, and the operatives are forced to return to their own plane of existence to avoid complete annihilation. Duncan makes a final request: leave behind a Black Box summary that advocates for the operatives’ vision as established across the Project TECHNOLOGIA experience. As the operatives complete their statement, they are pulled through the TSTT, and Remmlar Array implodes into a singularity that resets the station to its state immediately prior the operatives’ arrival, ready for a new group of graduate student technology coordinators.</td>
</tr>
</tbody>
</table>
APPENDIX B

PROJECT TECHNOLOGIA
PROMPT TRAJECTORY

PART I
EPISODE 1.1
Introduce your avatar to others; develop a persona to accompany the provided learning theory perspective

EPISODE 1.2
Summarize & restate assigned learning theory; align assigned perspective with the given purposes of education

EPISODE 1.3
Compare & contrast perspectives on learning theory; create an argument supporting assigned perspective

PART II
EPISODE 2.1
Establish role of an edtech coordinator; set priorities for progression of the technology plan development process

EPISODE 2.2
Create working definition of literacy as applied in edtech; define specific literacy needs for various stakeholders

EPISODE 2.3
Apply literacy to non-traditional reading & writing; determine how tech-based literacy programs can be evaluated

PART III
EPISODE 3.1
Describe how a tech coordinator & comprehensive tech plan can facilitate development of a shared vision

EPISODE 3.2
Categorize stakeholder groups; identify & analyze stakeholder group needs & desires

EPISODE 3.3
Identify & allocate resources needed for implementation of a comprehensive tech plan (e.g., human, financial)

EPISODE 3.4
Develop plans for short & long-term data protection; explain how to support strict controls while avoiding dangers tech presents

PART IV
EPISODE 4.1
Explain how to address tech professional development; describe ways to adapt tech plans for community needs

EPISODE 4.2
Identify failed admin & financial resources; describe how your vision can promote equity without causing dissent

EPISODE 4.3
Develop plans for short & long-term data protection; explain how to support strict controls while avoiding dangers tech presents

EPISODE 5.1
Describe how to motivate potential tech adopters & help them see tech potential, leading to wise integration

EPISODE 5.2
Reflect on how content, pedagogy, tools, and learning theory intersect for learning tech implementation (TPACK-L)

EPISODE 5.3
Generate professional development plans that demonstrate TPACK-L integration; help teachers utilize TPACK-L

PART V

EPISODE 6.0
Reflect on the content, lessons, and outcomes of the entire Master’s degree program; generate a cohesive message (incorporating advice and information about visioning, professional development production, and technology integration) for future avatars
Greetings, Operative.

This journal exists as a place for you to keep a log of thoughts, intentions, and motivations as you read, consider, and compose throughout Project TECHNOLOGIA. As you work on each episode, Mission Control asks that you take a few minutes to write down whatever comes to mind—this might include answers to questions like:

- What’s my motivation as a student/player?
- What do I see as my character’s motivation?
- What do I hope to accomplish with my response?
- What do I think about the story so far?
- What do I think about the prompt I’m working on?
- What do I think about my colleagues/peers and/or their characters’ decisions?
- What do I think about the non-player characters (i.e., the ones we don’t control)?

This is a place to reflect and “go meta” on the Project TECHNOLOGIA experience. We encourage brevity in your notes, but we also ask for the inclusion of any information you think might be relevant, big or small scale.

The journal will be kept confidential—the only people with access to it will be you and Special Agents [Instructor 1] and [Instructor 2]. Mission Control urges you to be as honest and outspoken as you see fit—no feelings will be hurt.

The journal is yours to modify as needed. Feel free to add a Table of Contents and/or bookmarks if it helps you page through it faster. It may help to organize your thoughts as a series of bullet points, but stream-of-consciousness is fine too. If at any point you find yourself with a question about maintaining this journal, feel free to contact Special Agent [Instructor 1] at [email address].
## Project TECHNOLOGIA Operative Thought Journal Codes

<table>
<thead>
<tr>
<th>Code Title</th>
<th>Sources</th>
<th>References</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Attitudes</strong></td>
<td></td>
<td>58</td>
<td>Individual expressions of one’s own attitude about game-based interactions</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Negative</em></td>
<td>4</td>
<td>11</td>
<td>Individual expresses pessimism and/or negative thinking regarding future</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>interactions in game environment</td>
</tr>
<tr>
<td><em>Positive</em></td>
<td>12</td>
<td>47</td>
<td>Individual expresses optimism and/or positive thinking regarding future</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>interactions in game environment</td>
</tr>
<tr>
<td><strong>Confusion</strong></td>
<td>10</td>
<td>26</td>
<td>Individual expresses confusion about format and/or interactions revolving</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>around the game</td>
</tr>
<tr>
<td><strong>Frustration</strong></td>
<td></td>
<td>60</td>
<td>How an individual views a particular challenge or series of challenges during</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>play</td>
</tr>
<tr>
<td><em>Pleasant</em></td>
<td>7</td>
<td>14</td>
<td>Individual suggests that a task(s) is challenging but feels that it is</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>solvable; individual is motivated by the challenge rather than deterred by</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>it (i.e., zone of proximal development)</td>
</tr>
<tr>
<td><em>Unpleasant</em></td>
<td>12</td>
<td>46</td>
<td>Individual suggests that a task(s) is challenging and feels that it is</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>unsolvable, irritating, and/or not worth the energy/time to overcome</td>
</tr>
<tr>
<td><strong>Goals</strong></td>
<td></td>
<td>75</td>
<td>Individual expressions about pre-existing and/or emergent goals related to</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>game play</td>
</tr>
<tr>
<td><em>Pre-Existing</em></td>
<td>8</td>
<td>32</td>
<td>Individual references an existing goal and/or preconceived notion about goal</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>trajectory during play</td>
</tr>
<tr>
<td>Category</td>
<td>Count</td>
<td>Code</td>
<td>Description</td>
</tr>
<tr>
<td>------------------------------</td>
<td>-------</td>
<td>------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Emergent</td>
<td>10</td>
<td>43</td>
<td>Individual references emergent goal(s) not previously described; new goal emerges through experiences with the game and/or external events being introduced to the game environment</td>
</tr>
<tr>
<td>Hesitation</td>
<td>12</td>
<td>38</td>
<td>Individual expresses hesitation about participating in game experience</td>
</tr>
<tr>
<td>Insight</td>
<td>12</td>
<td>55</td>
<td>Individual offers insight about the nature of the game-based learning environment, narrative, and/or instruction</td>
</tr>
<tr>
<td>Performance</td>
<td>10</td>
<td>66</td>
<td>Individual describes his/her behavior choices based on existing and/or emergent goals</td>
</tr>
<tr>
<td>Reaction to Others</td>
<td>12</td>
<td>50</td>
<td>Individual expresses reaction(s) to the performance and/or actions of peers</td>
</tr>
<tr>
<td>Reference to External Information</td>
<td>8</td>
<td>33</td>
<td>Individual introduces external experiences and/or information to explain a feeling, idea, and/or behavior related to gameplay</td>
</tr>
<tr>
<td>Reference to Narrative</td>
<td>14</td>
<td>81</td>
<td>Individual cites a specific mission, character, and/or plot point of the narrative</td>
</tr>
<tr>
<td>Suggestion</td>
<td>9</td>
<td>12</td>
<td>Individual offers a suggestion for how s/he would like to see the game format changed</td>
</tr>
</tbody>
</table>
# APPENDIX E

## Project TECHNOLOGIA Gameplay Codes

<table>
<thead>
<tr>
<th>Code Title</th>
<th>Sources</th>
<th>References</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acknowledging Others</td>
<td>62</td>
<td>89</td>
<td>Player directly acknowledges concerns, ideas, and feedback (or lack thereof) posed by other players and/or non-player characters</td>
</tr>
<tr>
<td>Collaboration</td>
<td>--</td>
<td>104</td>
<td>Player directly or indirectly refers to collaboration between various individuals within the game world</td>
</tr>
<tr>
<td>- Non-Player Characters</td>
<td>47</td>
<td>61</td>
<td>Player directly references collaboration and/or team work with respect to non-player characters</td>
</tr>
<tr>
<td>- Player Characters</td>
<td>36</td>
<td>43</td>
<td>Player directly references collaboration and/or team work with respect to other students playing the game (i.e., player characters)</td>
</tr>
<tr>
<td>Control</td>
<td>13</td>
<td>22</td>
<td>Player attempts to control a non-player character and/or some other part of the roleplaying game outside of their control</td>
</tr>
<tr>
<td>External Information</td>
<td>27</td>
<td>37</td>
<td>Player incorporates information from outside the game narrative (e.g., historical references, pop culture references, personal experiences, real world classroom events)</td>
</tr>
<tr>
<td>Forward Thinking</td>
<td>45</td>
<td>52</td>
<td>Player exhibits forward-thinking and/or planning around an idea rather than taking immediate action</td>
</tr>
<tr>
<td>Fourth Wall</td>
<td>14</td>
<td>16</td>
<td>Player directly addresses the audience, breaks character, and/or otherwise breaks internal consistency within the story</td>
</tr>
<tr>
<td>Goal Setting</td>
<td>40</td>
<td>59</td>
<td>Player refers to setting goals or objectives within the scope of the narrative</td>
</tr>
<tr>
<td><strong>Instructional Design</strong></td>
<td>37</td>
<td>51</td>
<td>Direct or indirect reference to ADDIE (e.g., focus groups, rapid prototyping) and/or other instructional design methodologies</td>
</tr>
<tr>
<td>-------------------------</td>
<td>----</td>
<td>----</td>
<td>--------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>Learning Theory</strong></td>
<td>46</td>
<td>70</td>
<td>Player directly or indirectly references particular learning theories or learning theory principles</td>
</tr>
<tr>
<td><strong>Visioning</strong></td>
<td>38</td>
<td>58</td>
<td>Player directly or indirectly references the development and/or implementation of a shared vision within the game context</td>
</tr>
<tr>
<td><strong>Skill(s)</strong></td>
<td>28</td>
<td>46</td>
<td>Player refers to end-user skill(s) (e.g., typing, reading, creating, critically thinking, problem solving)</td>
</tr>
</tbody>
</table>
Project TECHNOLOGIA Emergent Categorical Themes

<table>
<thead>
<tr>
<th>Theme</th>
<th>Contributing Codes</th>
<th>Description</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Attitudes</strong></td>
<td>Thought Journal (TJ); Hesitation; Confusion; Attitudes</td>
<td>Game-based environment can be unfamiliar, confusing, and/or intimidating to individuals with little gaming experience</td>
<td>“I like the idea but still am having a hard time really ‘getting into it’.”</td>
</tr>
<tr>
<td></td>
<td><em>Project TECHNOLOGIA Dialogue (PT)</em>; Fourth Wall</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Interface</strong></td>
<td>TJ: Confusion; Frustration; Suggestion</td>
<td>Blackboard™ interface is non-optimal for storytelling and/or gaming</td>
<td>“If you don’t log on for a few days, it’s hard to backtrack and read all the responses since it’s a ‘reply’ button system.”</td>
</tr>
<tr>
<td></td>
<td>PT: --</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Worldview Mechanic</strong></td>
<td>TJ: Frustration; Performance; Goals; Reference to External Information; Suggestion</td>
<td>The Learning Theory Worldview Mechanic requires better scaffolding and possibly a training module of its own</td>
<td>“I’m having trouble incorporating the schema theory background into my post.”</td>
</tr>
<tr>
<td></td>
<td>PT: Learning Theory; Visioning; Goal Setting; Skills; Acknowledging Others</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Application and Transfer</strong></td>
<td>TJ: Frustration; Performance; Goals; Reference to External Information; Insight; Reaction to Others; Reference to Narrative</td>
<td>Pleasant frustration is closely associated with applying information learned throughout the course of the program</td>
<td>“I find the responses of the participants to gradually build upon what I envision their character should be. This leaves me anticipating their next move.”</td>
</tr>
<tr>
<td></td>
<td>PT: Acknowledging Others; Goal Setting; Forward Thinking; External Information; Skills</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Player Agency</strong></td>
<td>TJ: Frustration; Performance; Goals; Reaction to Others; Insight; Suggestion</td>
<td>Unpleasant frustration is closely associated with limits to player agency; leads to disengagement and/or negative attitudes toward play</td>
<td>“I teach in a district that has a BYOD policy, and I am having a problem with the hostility and resistance to the tablet use.”</td>
</tr>
<tr>
<td></td>
<td>PT: Acknowledging Others; Collaboration; Control; Fourth Wall; Goal Setting</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Creativity</td>
<td>Interaction through co-writing affords opportunities for improved creative thinking</td>
<td>“I found myself giving some suggestions for next steps and also questioning my fellow avatars this week, which I think is the right direction in which to head”</td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td>PT: Collaboration; Control; External Information; Forward Thinking; Goal Setting; Instructional Design</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TJ: Frustration; Performance; Goals; Insight; Attitudes; Reaction to Others; Reference to External Information; Reference to Narrative</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Narrative</th>
<th>Story co-construction contributes to increased engagement, especially among participants who enjoy science fiction</th>
<th>“SOOOO much of education is about what could happen, and there is often a lack of action. I’m interested to see where the action will happen. ;)”</th>
</tr>
</thead>
<tbody>
<tr>
<td>PT: Acknowledging Others; Collaboration; External Information; Fourth Wall; Goal Setting</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TJ: Reference to Narrative; Goals; Attitudes; Reference to External Information; Insight</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Collaboration</th>
<th>Player-player and player-instructor dialogue leads to the most memorable experiences; play is most rewarding when collaborative, not treated as individualized</th>
<th>“I love seeing ‘frustrated’ posts from [Wayne], and I wonder if he is truly frustrated because we’ve been a little slow on the uptake”</th>
</tr>
</thead>
<tbody>
<tr>
<td>PT: Acknowledging Others; Collaboration; Goal Setting</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TJ: Reaction to Others; Goals; Attitudes; Insight; Reference to Narrative</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Pre-Existing Intentionality</th>
<th>Pre-existing goals and trajectories for fulfillment of those goals primarily revolve around personal lives, prior gaming experiences, and established philosophies of education</th>
<th>“I wanted to show what I thought were the most important aspects of technology in education and how to set up successful systems that will last and are centered around those key ideas.”</th>
</tr>
</thead>
<tbody>
<tr>
<td>PT: External Information; Fourth Wall; Goal Setting; Learning Theory</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TJ: Goals; Attitudes; Reaction to Others; Reference to Narrative; Performance</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Emergent Intentionality</th>
<th>Emergent goals arise primarily in response to non-player character behaviors and induce transfer between in- and out-of-game contexts</th>
<th>“Rheeghen needs some calming down. I’m going to have to work with her. I once read a book (well skimmed it), called Even Mystics have Bills to Pay, I’ll work that in somehow.”</th>
</tr>
</thead>
<tbody>
<tr>
<td>PT: External Information; Collaboration; Forward Thinking; Goal Setting; Instructional Design; Learning Theory; Visioning</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TJ: Goals; Attitudes; Reaction to Others; Reference to Narrative; Performance</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Good evening and welcome!

My name is Stephen Slota, and I am a doctoral candidate in educational psychology at the University of Connecticut. I am also the primary developer of a new, game-based learning program for educational technology instruction and would like to formally introduce you to what you’ll be doing this spring.

Project TECHNOLOGIA, as it’s called, is a text- and picture-based instructional environment that draws on the most successful elements of exploratory-anchored instruction to help students tell the story of their learning through a semester-long educational technology curriculum. The program has been developed with an emphasis on improving student achievement in educational technology through a series of immersive, content-rich narrative scenarios that have been paired at a 1:1 ratio with state and national standards (i.e., NETS/ISTE). Working in Blackboard™ (i.e., HuskyCT), my team and I have been able to safely and easily bring Project TECHNOLOGIA to any traditional web browser, capitalizing on growing teacher/researcher interest in the field of game-based learning (for more information, see the New Media Consortium's 2011, 2012, and 2014 Horizon Reports on emerging educational technologies).

This program is an interactive adventure that will require you to actively demonstrate your learning with a group guide continually reviewing your skills in visioning, critically thinking, problem solving, and reasoning like an in-service educational technologist. While it is game-like in many respects, it is also an ongoing collaborative performance: Project TECHNOLOGIA encourages students to co-learn with peers and professors in order to highlight the growth and development of the abilities they’ve honed since starting the [graduate program]. This is education as experiential, project-based, and problem-based learning: learning by doing.

While research may be conducted once Project TECHNOLOGIA is finished, we want you to know that your participation will not be compulsory—that is, you’ll be asked specifically whether or not you’re interested in having your contributions to the program included in data collection and/or analysis.

If you would like more information about Project TECHNOLOGIA and the theoretical foundations on which it’s been built, please feel free to contact me via email (stephen.slota@uconn.edu) or phone (860-794-4081) at your convenience.

Thank you very much for your help in making Project TECHNOLOGIA possible.

Sincerely yours,

Stephen T. Slota, MA
University of Connecticut
Department of Educational Psychology
Cognition, Instruction, and Learning Technologies
Consent Form for Participation in a Research Study

University of Connecticut

Principal Investigator: Michael F. Young, PhD
Student Researcher: Stephen T. Slota, MA
Study Title: Project TECHNOLOGIA: A Game-Based Approach to Understanding Situated Intentionality

Introduction

You are invited to participate in a research study examining the effectiveness of a text- and picture-based program called Project TECHNOLOGIA, an instructional tool designed to blend educational technology content with 21st century research skills and opportunities to express what you’ve learned across the [graduate program]. You are being asked to participate because you have used Project TECHNOLOGIA during the 2013-2014 academic year.

This permission form will give you the information you will need to understand why this study is being done and why you are being invited to participate. It will also describe what you will be asked to do to participate and any known risks and inconveniences you may have while participating. We encourage you to ask questions now and at any time. If you decide to participate, you will be asked to sign this form, and it will be a record of your permission to allow us to review the stated materials. You will be given a copy of this form.

Why is this study being done?

We are conducting this research study to establish interaction(s) between student/player intentionality, an instructionally-relevant game (i.e., Project TECHNOLOGIA), and student outcomes in a Master’s-level educational technology program. By better understanding the way game mechanics influence student learning, the educational community may begin to isolate the useful elements of game-based coursework.

This study will provide: information about the development and evolution of student intentions for learning with the introduction of a dual alternate reality-roleplaying narrative (i.e., Project TECHNOLOGIA); an analysis of student discourse with respect to educational technology content set within a dual alternate reality-roleplaying narrative (i.e., Project TECHNOLOGIA); correlates of success in traditional versus game-based instructional settings; and implications for the ongoing development of educational games writ large.
What are the study procedures? What will I be asked to do?

If you give permission to take part in this study, you will be asked to allow us to collect information from your GoogleDoc thought journal and the group work you’ve completed throughout Project TECHNOLOGIA. It is important to note that the study itself will not affect your grades or treatment in the [graduate program].

Should you choose to participate in this study, the researchers will review your contributions in HuskyCT and the notes you’ve made in your GoogleDoc thought journal. Once that material has been screened, it will be assigned a number and/or pseudonym so your identity will remain completely anonymous to everyone except the researchers. No individual score, grade, or contribution will be traceable to any individual [graduate] student by anyone except that student and the researchers.

The second portion of the study will involve an examination of overall [graduate] portfolio performance as correlated to Project TECHNOLOGIA performance. The researchers will use numerical assessment data to enrich the qualitative data taken from your post and journal contributions. Like your text contributions, these scores will be assigned a code number so your identity will remain completely anonymous to everyone except the [graduate] student by anyone except that student and the researchers.

What are the risks or inconveniences of the study?

Though you have been required to utilize internet services (e.g., HuskyCT) to complete your Project TECHNOLOGIA work, the website represents a closed system that is directly monitored and moderated by your instructor. The collection and evaluation of data has been designed to reduce interference with the traditional instructional process as much as possible, going so far as to purposefully complement it. Student thought journals will only be known to you and the researchers. The technologies and instructional methods used to conduct this research are already present and relied upon by master teachers, including other UCONN faculty.

What are the benefits of the study?

If, as previous research has suggested, game-based learning has affordances for certain student populations, students engaged in Project TECHNOLOGIA may experience enhanced learning outcomes in areas such as attitude, engagement, behavior, and academic achievement. This may serve as a way to improve upon and combine the already-established benefits of differentiation, student constructivism, and inquiry-based learning. Moreover, the combination of student self-study and teacher-facilitated reflection may lead to positive outcomes for students taking on technology coordinator positions at their respective schools. This could have broadly reaching positive effects with respect to district funding, teacher evaluation, and future district curriculum development.
Will I receive payment for participation? Are there costs to participate?

There are no costs and you will not be paid to be in this study. No monetary compensation will be provided for participation in this study. However, individuals who choose to participate will also be granted the following benefits:

- A free deck of CARD-tamen™ CARDS (i.e., a specially-designed deck of educational technology playing cards based on the commercially-available CARD-tamen™)
- Priority for helping to moderate and/or provide instruction in future iterations of *Project TECHNOLOGIA* (i.e., a possible opportunity to help design portions of the revised *Project TECHNOLOGIA* narrative and implement it as an associate instructor)

How will my personal information be protected?

The following procedures will be used to protect the confidentiality your data:

1. No student grades will be collected or made visible through HuskyCT or the GoogleDoc thought journals.
2. Information pertaining to an individual participant will not be made available to anyone except that participant and the researchers.
3. No participants will have access to other participants’ information except for the final research paper(s). These will be stripped of all identifying information by the researchers.
4. All data collected over the course of the study will be stored in an encrypted external hard drive to be secured in a locked University of Connecticut Department of Educational Psychology office and cabinet.
5. All participant names, assessment scores, institutions, and other potentially identifying information will be stripped from the relevant materials. Participant identities will be known only to the researchers and the corresponding participant.
6. Any and all participant information required during data analysis will be removed and replaced with pseudonyms and/or code numbers.

We will do our best to protect the confidentiality of the information we gather from you but we cannot guarantee 100% confidentiality. Your confidentiality will be maintained to the degree permitted by the technology used. Specifically, no guarantees can be made regarding the interception of data sent via the Internet by any third parties.

You should also know that the UConn Institutional Review Board (IRB) and the Office of Research Compliance may inspect study records as part of its auditing program, but these reviews will only focus on the researchers and not on your child’s responses or involvement. The IRB is a
group of people who review research studies to protect the rights and welfare of research participants.

**Can I stop being in the study and what are my rights?**

You do not have to be in this study if you do not want to. If you agree to be in the study, but later change your mind, you may drop out at any time. There are no penalties or consequences of any kind if you decide that you do not want to participate.

**Whom do I contact if I have questions about the study?**

Take as long as you like before you make a decision. We will be happy to answer any question you have about this study.

If you have further questions about this study or if you have a research-related problem, you may contact the principal investigator, Dr. Michael Young (michael.f.young@uconn.edu; 860-486-0182) or the student researcher, Stephen Slota (stephen.slota@uconn.edu; 860-794-4081). If you have any questions concerning your rights as a research participant, you may contact the University of Connecticut Institutional Review Board (IRB) at 860-486-8802.
Consent Form for Participation in a Research Study

Principal Investigator: Michael F. Young, PhD
Student Researcher: Stephen T. Slota, MA
Study Title: Practomime: A Situated Approach to Game-Based Learning

Documentation of Consent:

I have read this form and decided that I will participate in the project described above. Its general purposes, the particulars of involvement, and possible risks and inconveniences have been explained to my satisfaction. I understand that I can withdraw at any time. My signature also indicates that I have received a copy of this consent form.

__________________________________  __________________________  _______
Participant Signature                Print Name                          Date

__________________________________  __________________________  _______
Researcher Signature                 Print Name                          Date