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Student-Centered Factors as Predictors for Learning and Motivation in Digital Games: Examining a Deception Detection Training Game

A dissertation submitted in partial satisfaction of the

requirements for the degree Doctor of Philosophy

in Communication

by

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ABSTRACT

Student-Centered Factors as Predictors for Learning and Motivation in Digital Games: Examining a Deception Detection Training Game

by

Aubrie Serena Adams

Early scholars in the field of game studies praised digital games for their potential to impact teaching and learning processes; however, this one-size-fits all approach to games in education may not effectively improve learning for all types of students. Their interests, beliefs, goals, needs, and knowledge (which can be called student-centered factors) may play a role in their ability to learn from a game-based training. The goal of this dissertation is to examine the conditions in which learners are more likely to benefit from a digital training game. Rather than manipulating the features of a game to examine the impact on students, the current study examines the students themselves.

To examine the degree that pre-existing student-centered factors can be used to predict a person's likelihood of learning and motivation in digital game-based training, a sequential mixed-methods design was utilized in which both qualitative and quantitative data were gathered in three different data collection stages. Study I (Chapter III) utilized a survey method to pilot test the instrumentation that was designed to measure five student-centered factors of interest in this study. Study II (Chapter IV) was exploratory and used both focus group and interview methods to examine participant experiences after play-testing an alpha version of a digital learning game, VERITAS. Study III (Chapter V) used a pretest-posttest experimental design to assess the degree that student-centered factors impact learning between two types of training conditions and assessed the degree that student-centered factors predict four types of motivation (outcome-focused, process-focused, means-focused, and intrinsic motivation).

Five key findings summarize the most notable outcomes of this research: first, the game-based training contributes to higher levels of learning in comparison to a PowerPoint lecture-based training; this is especially the case for learners who report that English is not their first language. Second, having a stronger interest in the topic of deception detection is positively related to perceptions of enjoyment and value (intrinsic motivation) in the game-based training. Third, having a stronger belief in one's ability to learn about the topic of deception detection is negatively related to one's experience in attending to goals (process-focused motivation); but is positively related to perceptions of competence in the game-based training. Fourth, having a goal that is oriented toward mastering a topic is negatively related to the effort that a user reports putting into the training game. Lastly, having needs that are more likely to be satisfied in digital games is positively related to asking more in-game questions in a game-based training (means-focused motivation); but is negatively related to one's perceptions of value in the training.

From a new media perspective, this research explores the affordances and limitations of games in education. Findings overall show that users are likely to interact with a digital learning tool based on their own unique prior experiences. By seeking to understand the relationship between student-centered factors, learning, and motivation, scholars can better design games to serve diverse students in our evolving digital age.

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"All of the neurological and physiological systems that underlie happiness—our attention systems, our reward center, our motivation systems, our emotion and memory centers—are fully activated by gameplay" – McGonigal (2011, p. 30)

"Serious games can be complex (learning) environments, and it is not always the case that students playing serious games will automatically engage in the aforementioned cognitive processes or that the characteristics of the game trigger (intrinsic) motivation"
– Wouters & van Oostendorp (2017, p. 4)

When digital games first emerged in the 1960's, educators envisioned the potential of using these tools as training devices (Abt, 1970). Soon after, in 1971, *The Oregon Trail* emerged and quickly showed the impact digital games could have on formal education systems. *The Oregon Trail* was a digital game designed to teach eighth-grade history by encouraging students to think more deeply about what life was like for pioneers traveling along 2,000 miles of the dangerously harsh Oregon Trail during the mid-1800s. The game went on to become widely accessible and successfully integrated into classroom curriculums with over 65 million copies sold in the past four decades (Adams, 2017). *The Oregon Trail* demonstrated the potential digital games could have in educational environments. Other similar learning games began to emerge, such as *Where in the World is Carmen Sandiego?* (1985), *Reader Rabbit* (1986), and *The Yukon Trail* (1994).

Digital Game-Based Learning

Despite early adoption of digital game-based learning (DGBL) in school systems, empirical studies examining the effectiveness of learning games remained scant for decades (Mayer, 2014a). Progress in game studies was likely slowed by a debate in the literature that questioned the value of research on games as a distinct area of academic inquiry. Because critics viewed game scholarship as a subdomain within the broader discipline of mass media studies, scholarship that focused specifically on digital games before the early 2000's was at an inchoate stage. But when the *Journal of Game Studies* emerged in 2001, it provided a foundation for research on digital games to function for the first time as a distinct, viable, internationally focused, and coherent discipline (Aarseth, 2001; Perron & Wolf, 2008). To provide consistency to the terminology used within this growing domain, scholars conceptualized the boundaries of the field of games studies and clarified the definition of games (Juul, 2005). Though one broad definition purports that games exist as rule-defined activities that encourage players to seek goals (Galloway, 2006), a more precise definition adds that digital games are inviting and accumulative simulations that feature interactivity, rules, responsiveness, and challenges (Mayer & Johnson, 2010).

With the establishment of game studies as a distinct area of inquiry, several pioneers in the discipline became advocates for digital games and praised their potential to enhance educational practices and revolutionize student learning (Bogost, 2011; Brown, 2006; Foreman, 2003; Gee, 2007; Koster, 2004; McGonigal, 2011, 2015; Prensky, 2005; Rockwell & Kee, 2011; Shaffer, 2006; Squire, 2011; Steinkuehler, 2008). Providing terminology to this discourse, the term *gamification* was adapted, referring to a process in which elements of gameplay are added to enhance educational training practices (Kapp, 2012). Given this rise in advocacy, a movement toward gamification accelerated. Case in point: during President Obama's administration, a government plan was proposed to spend approximately four billion dollars on strategies designed to promote computer science education using video games as an entry point to learning (Makuch, 2016). Undeniably, digital games have garnered much attention from scholars, teachers, and policy-makers alike.

Unfortunately, little is known regarding what factors best contribute to an effective digital learning game to this day. Though early advocates provided reasonable arguments regarding the potential impact games could have on learning, initial arguments in this vein were based primarily on anecdotes, examples, and visions rather than empirical studies (Mayer, 2014a). Prensky (2005) claimed that children could learn more useful information from video games than from school; Shaffer (2006) asserted that digital games could provide the key to solving educational crises; and McGonigal (2011) argued that games could help us change reality to invent our future. Although these claims remain compelling and inspire scholars to tackle research on digital games, this discourse does not in itself provide robust systematic evidence to demonstrate what features of games are effective in teaching and learning. Similarly, this discourse overlooks the potential for pre-existing student attributes that may influence student performance in DGBL contexts.

Further compounding this issue, research on the effectiveness of DGBL provides inconsistent results. Mayer (2014a) performed a review of extant literature between 1991 through 2012 and identified eight major papers that performed summative reviews in computer games for learning (literature reviews and meta-analyses). A review of these studies shows that games do not consistently contribute to higher learning outcomes and they sometimes produce poorer outcomes than traditional methods. In a more recent meta-analysis, Wouters and van Oostendorp (2017) reviewed existing research on DGBL between 1990 through 2016 to find 50 studies that fit their criteria for inclusion. Although they found that games improved learning, this was dependent upon the specific instructional technique featured in the game, and some games performed better than others. Taken together, these studies indicate that DGBL might not be the one-size-fits-all solution to improving education for all learners as was initially theorized by proponents in the field.

Given the potential for inconsistent results regarding the effectiveness of DGBL, this suggests that more research is needed to better understand the contexts in which digital games are effective. Nonetheless, decades of research on video games more broadly indicates the positive and cognitive impacts of games: digital games can be used to promote physical health (Lieberman, 2012), cognition (Anguera et al., 2013), socialization (Jansz & Martens, 2005), the reduction of cognitive biases (Dunbar et al., 2013), and higher levels of well-being, less depression, and less negative affect (Allaire et al., 2013). Evidence further demonstrates that games can be used to improve accuracy in triage training in medical contexts (Knight et al., 2010), engagement in engineering coursework (Coller & Shernoff, 2009), and prosocial thoughts about helping others in social contexts (Greitemeyer & Osswald, 2010). Digital games can clearly have a variety of positive benefits for users; therefore, educators must seek to understand the contexts in which the benefits of digital games can be harnessed to improve teaching and learning.

Pragmatic research must continue to explore the implications, affordances, and limitations regarding the effective usage of digital games in education. To guide future investigation on games in learning, Mayer (2014a) proposed four central questions that scholars should next address: (1) What methods work in improving learning? (2) When do these methods work and under what types of conditions? (3) How do these methods work and what are the cognitive mechanisms that lead to success? (4) What happens to the participants and what do they do when they are playing a game? Tackling questions in these four domains provides researchers a launching point to empirically study the effective usages of DGBL and to push the boundaries of the discipline. The present study focuses on the second question in this group to help educators understand the contexts in which a training game may be effective for specific types of users.

The goal of this dissertation is to examine the conditions in which learners are more likely to benefit from a digital training game. Rather than manipulating the features of a game to examine the impact on students, the current study examines the students themselves. It is hypothesized that a student's pre-existing perceptions related to games and learning may influence their motivation to learn when playing a digital training game and their learning outcomes. Before delving further into the literature and theoretical developments that underlie the DGBL hypotheses made in this study, it is first necessary to describe the specific context for the learning game that will be tested. This study examines a newly developed digital training game that is designed to teach knowledge and skills about deception detection. Therefore, the topic of deception detection training is introduced next.

Deception Detection Training

The average human can identify the difference between truths and lies at only a 54% accuracy rate (Bond & DePaulo, 2006). These odds are only slightly better than flipping a coin. Research also shows that people, despite possessing deception detection abilities that are tenuous at best, are likely to believe they are much better at detecting deception than they actually are (DePaulo, Charlton, Cooper, Lindsay, & Muhlenbruck, 1997). Though most people are likely to be duped by low stakes lies with minimal consequences, others may be misled by high stakes lies that significantly impact a person's wellbeing, safety, or livelihood. In particular, law enforcement officers and intelligence analysts are required to make high stakes credibility assessments on a daily basis. Though conventional trainings exist to teach officers to distinguish between deceptive and truthful behaviors, studies show that officers are no better at detecting deception than the average untrained citizen (Granhag & Vrij, 2010; Talbot, 2012). Thus, police officers need a training program to better teach them to distinguish between truths and lies.

A variety of studies consider the effectiveness of deception detection training programs. In a review of the extant research, Driskell (2012) performed a meta-analysis that examined sixteen studies on deception detection trainings. Findings indicated that training effectiveness was moderated by four variables: (1) the type of training; (2) the training content; (3) the expertise level of the trainee; and (4) the type of lie told. Overall, trainings were significantly more effective when trainees were naïve (e.g., untrained citizens) rather than experienced (e.g., trained police officers). In a similar meta-analysis, Hauch, Sporer, Michael, and Meissner (2014) examined thirty deception detection training studies. Findings showed that trainings contributed to an improved ability to detect deception with a small to medium effect size. Trainings that featured written instructions in combination with lectures or videos had stronger effects than training programs that used lectures or videos alone. Taken together, a variety of factors may influence one's ability to effectively learn deception detection skills including the expertise level of the trainee and the type of training.

The fact that trainings are significantly less effective for experienced trainees (e.g. trained police officers) is concerning. One must wonder why law enforcement officers, with presumably more experience encountering deception, are less likely to benefit from the effects of additional training. Research on cognitive biases may explain this phenomenon. Much is known regarding how a person's pre-existing biases may function as a barrier to accurately detecting deception (Burgoon, Blair, & Strom, 2008; Vrij, 2006). Three heuristic strategies (cognitive biases) are provided as examples: confirmation bias, visual bias, and demeanor bias.

First, *confirmation bias* refers to a heuristic strategy in which a person makes a premature decision to determine the credibility of a message early on in an interaction. If an interviewer believes a suspect is lying, the interviewer may continue to look for evidence that supports that belief and may miss evidence that shows the contrary (Oswald & Grosjean, 2004). Second, *visual bias* refers to the idea that an interviewer tends to look for visual nonverbal deception cues; moreover, they often refer to the wrong cues and misinterpret indicators of honesty and deception. As a result, they may miss verbal cues, which in many cases have been shown to function as better indicators of deception than nonverbal cues overall (Burgoon et al., 2008). Finally, *demeanor bias* occurs when people believe a message simply because the speaker looks like a credible person (Riggio, Tucker, & Throckmorton, 1987). Studies demonstrate that cognitive biases such as these ultimately interfere with one's deception detection ability (Burgoon et al., 2008; Vrij, 2006).

Furthermore, many people hold false beliefs about indicators of effective deception detection; these false beliefs function as myths within popular society. For example, though research shows that liars and truth-tellers do not actually differ in their eye gaze behaviors (Mann et al., 2012), a cross-cultural examination of attitudes about deception from 58 different countries indicates that 64% of people inaccurately believe a lack of eye contact is a reliable deception cue (The Global Deception Research Team, 2006). Police officers hold similar inaccurate beliefs: 73% of officers in one study also indicated avoiding eye gaze was a deceptive behavior (Mann, Vrij, & Bull, 2004). Although people believe that signs of nervousness and other body movements, such as self-fidgeting, are likely signs of deception (The Global Deception Research Team, 2006), these cues are also often misinterpreted and are not the most reliable indicators (DePaulo et al., 2003).

Studies have identified more reliable research-based cues of truth and deception. DePaulo et al. (2003) performed a meta-analysis that combined results from 120 samples to examine 158 possible cues. They found 23 cues were the most diagnostic for distinguishing between truth and lies (with significant effect sizes ranging from small to medium: $d = .21$ to

.66). The following verbal and nonverbal indicators were found to be more reliable cues of *truth-telling:* (1) verbal and vocal immediacy impressions (i.e., indicators of closeness and involvement); (2) including details; (3) logical structure; (4) plausibility; (5) verbal and vocal involvement; (6) contextual embedding; (7) cooperation; (8) admitting a lack of memory; (9) talking time; (10) verbal immediacy; and (11) spontaneous corrections. Similarly, they found that the following verbal and nonverbals cues were more reliable indicators of *deception*: (1) discrepant information; (2) verbal and vocal uncertainty; (3) overall tension; (4) vocal tension; (5) frequency & pitch, (6) negative statements; (7) pupil dilation; (8) referencing points external to the situation; (9) raised chin; (10) statements on another's mental state; (11) repetitions; and (12) self-deprecation. These cues relate to three general patterns overall: signs of uncertainty, cognitive load, and tension. Given these diagnostic cues based on rigorous empirical investigation, trainings in the future can focus on teaching these types of indicators; this should help reduce the reliance on cognitive biases and inaccurate deception stereotypes.

However, people are not likely to be consciously aware that they hold these inaccurate beliefs or utilize these biases (Pronin, 2007). Therefore, pre-existing schemata, or ways of thinking about deceptive behavior, are likely to negatively impact a person's motivation to seek out new ways of learning deception detection strategies and this may contribute to individuals who are resistant to training. This lack of motivation may pose a barrier; an unmotivated person may not engage with a training program in the same way a more motivated person behaves. This may explain why experienced-trainees learn less than naïve-trainees; experienced trainees may actually utilize cognitive biases, myths, and stereotypes that they have become accustomed to using in trying to identify deceptive behaviors. Experienced trainees may also be unmotivated to learn new or more effective strategies. Thus, experienced trainees may need a training program that is particularly motivating to best teach them to distinguish between truths and lies. This is especially the case when a user does not believe she or he is need of training and when training may be perceived as a threat to one's professional identity, which may be the case for experienced trainees, such as police officers. Therefore, DGBL may be ideally situated to function as a training program that motivates users to learn research-based deception detection strategies.

Digital Games and Deception Detection

This dissertation has introduced what may seem to be two disparate fields of study: DGBL and deception detection. These topics are introduced as primers to (1) explain the need for greater research on digital games in education and to (2) clarify the topic of the training game that is tested in this study, which is designed to teach deception detection. Because video games provide both intrinsic and extrinsic rewards (Deci & Ryan, 2008), motivation to learn from a game may be higher than learning from a conventional training. When a training itself provides little motivation, or when it appears threatening to one's self-concept and sense of abilities, games may function as more motivating training tools. This is what makes the context of deception detection training especially suited to function as a game-based training. As mentioned previously, a variety of factors may influence one's ability to effectively learn deception detection, including the expertise level of the trainee and the type of training. Cognitive biases and stereotypes may also influence ones' motivation to put effort into practicing more effective deception detection strategies. Therefore, a training game designed to teach deception detection provides a unique opportunity to explore the complex area of learner motivations in digital games.

At present, a research team (led by primary investigator, Norah E. Dunbar) is collaborating across the United States to develop and test a new digital learning game called

Veracity Education and Reactance Instruction through Technology and Applied Skills (VERITAS). With funding sponsored by the National Science Foundation (NSF), the goal of VERITAS is to teach law enforcement officers and laypersons alike deception detection knowledge and skills. Ultimately, the project goals are to develop a game that (1) motivates users to learn more effective deception detection strategies and (2) teaches research-based cues of truth and deception so users do not rely on cognitive biases or myths in making credibility assessments (see Chapter IV for a full description on how VERITAS functions).

This study provides a unique contribution to the field of DGBL. Whereas many studies suggest that video games are motivating for all users (Ryan, Rigby, & Przybylski, 2006) a theoretical overview shows that numerous pre-existing student-centered factors may impact motivation to learn (see Chapter II). A gap exists in the literature: whereas researchers assume that games are motivating for all players, studies need to better explain the contexts in which motivation to learn from a game is higher or lower for unique users.

The goal of this dissertation is to examine some of the conditions in which learners are more likely to benefit from DGBL. It is predicted that a student's pre-existing perceptions related to games and learning may influence their motivation to learn when playing a digital training game on deception detection. In Chapter II, extant literature on digital games and student motivation is reviewed to provide the theoretical underpinnings that inform the hypotheses tested in this study. In Chapter III, a pilot study tests a measure developed to explore pre-existing student-centered factors. In Chapter IV, focus groups and interviews are used to explore participant experiences and motivation in playing VERITAS. In Chapter V, the main experiment tests the influences of student-centered factors on motivation to learn from the game. In Chapter VI, a general discussion summarizes results and proposes new directions for future research.

II. Literature Review and Hypotheses

Game-based learning may provide teachers and students with digital tools that can facilitate educational practices beyond the face-to-face classroom. As mentioned before, a variety of advocates praise digital games in their potential to enhance educational practices and revolutionize classroom procedures (Bogost, 2011; Brown, 2006; Foreman, 2003; Gee, 2007; Koster, 2004; McGonigal, 2011; Prensky, 2005; Shaffer, 2006; Squire, 2011). Because video games provide both intrinsic and extrinsic rewards (Deci & Ryan, 2008), motivation to learn from a game may be higher than learning from a conventional training. Though games may function to motivate players, it would be a mistake to assume that a video game in itself is sufficient to motivate all types of learners. In fact, there may be certain contexts and conditions in which some users may be more motivated to learn from a game compared to others.

Few studies adequately explain the theoretical mechanisms that predict effective DGBL for specific users. To ameliorate this inadequacy, one can apply existing communication science and educational theories to provide a framework that begins to organize and explain the pedagogical features of games and the way these features may impact diverse students. Several theories make predictions regarding how student-centered pre-existing factors may influence motivation. Though there is not much research that examines the ways that adults (such as police officers) learn and receive training explicitly, research on education that examines children and young-adults can be applied to explain learning in general. To understand how student-centered factors may impact motivation and learning, it is necessary to first explicate how DGBL functions in general before exploring research on student-centered factors more specifically.

This literature review is divided into the following three key areas of research: First, learning in digital games is explicated to provide a review of the (a) theories; (b) best practices; (c) ongoing challenges; and (d) methods used to study DGBL. Second, motivation in digital games is also explicated. Third, five pre-existing student-centered factors are reviewed and organized into a final model that is used to predict learning and motivation in digital games.

Explicating Learning in Digital games

Learning refers to the process of creating an enduring mental change within an individual such as a change in insight, behavior, perception, or motivation that is not otherwise due to genetic maturation; it is a systematic change in behavior or disposition that occurs as a direct result of experience (Bigge, 1982). A *theory,* in its most basic form, is considered a collective explanation of how a process works (Shoemaker, Tankard, & Lasorsa, 2004). *Social science theories* broadly allow scholars to describe, explain, predict, and control social phenomena (West & Turner, 2014). In combining these conceptualizations, a *learning theory* is a systematic and integrated explanation that allows researchers to better understand processes of learning (Bigge, 1982).

Though learning is a natural process that occurs because of experience, formal education systems face numerous problems in effectively teaching masses of students simultaneously. An unfortunate reality in education is that course content is not always immediately relevant to routine matters of everyday life, teaching effectiveness is often problematically measured by student performance on standardized tests, and course material can appear uninteresting to students (Bigge, 1982). Given these issues, learning theories are used to help educators better describe, explain, predict, and control teaching methods to best assist individual learners.

Digital games have been introduced as one such tool that can help users learn by combining the benefits of video games with intentionally designed learning experiences. Several taxonomies categorize different types of digital games (Djaouti, Alvarez, & Jessel, 2011) but the most parsimonious divides them into two broad categories: (1) entertainment games and (2) serious games. *Entertainment games* (interchangeably called commercial off-the-shelf games) are designed with a large consumer audience in mind. These are games freely chosen by users that function as a form of recreation, enjoyment, and pastime (Boyle, Connolly, & Hainey, 2011). In contrast, *serious games* are intentionally created with a more specific audience in mind; these are games designed to create an enduring mental change or impression in a person that impacts their insight, behavior, perception, or motivation (as mirrored from the definition of learning; Bigge, 1982). In other words, serious games are designed to teach and train (Boyle et al., 2011; Mayer, 2014a).

Though all games have the potential to teach, two primary methods of game creation distinguish serious games from other types. The first method refers to the creation of a serious game that is designed intentionally from the ground up to teach a specific topic. The second method refers to a process in which elements of gameplay are added to enhance a pre-existing educational or training practice: a process called *gamification* (Kapp, 2012). Both methods provide a route to create a serious game. Bogost (2007) describes three broad types of serious games: political games (used to call for social action), advertising games (used to advertise products), and learning games (used for training). As one explicit type of serious game, *digital game-based learning* (DGBL) functions specifically as a type of digital simulation that is designed to improve a player's knowledge or skills through game play (Boyle et al., 2011; Mayer, 2014a).

Theories. Learning theories are broadly used to explain how and why people learn, how the process of development works, how individual differences affect learning, and how learning outcomes are measured (Snowman, 1997). Because DGBL is a relatively new phenomenon, few theories explicitly explain learning in the specific context of digital games. Instead, existing learning theories can be applied as a lens to examine the ways in which games work to influence learning. This review primarily draws upon a cognitive approach to explore theories that explain DGBL.

Scholars utilize a cognitive perspective to examine the way that the human brain represents and processes information. According to Vousden, Wood, and Holliman (2014) the role of a teacher within the cognitive approach is to present information in a way that best facilitates cognitive functioning. Much research within this perspective draws upon Bruner's (1977) principle of structure, which states that teachers should not simply focus on student memorization; instead they should seek to carefully plan the structure of information to best help students integrate new knowledge. In the following, two theories that utilize a cognitive perspective are explained in relation to DGBL: *Automaticity Theory* and *Cognitive Load Theory*. A brief overview of these two theories shows how the way information is structured for users plays a role in teaching and learning processes.

Automaticity Theory. As described by Mayer (2014), the main premise of *Automaticity Theory* is that learning takes place through a three-step process: (1) the encoding stage; (2) the associative stage; and (3) the autonomous stage (Fitts & Posner, 1967; Singley & Anderson, 1989). Within the *encoding stage*, information is received by the brain and information processing begins. In the *associative stage*, information is applied following a step-by-step approach that requires conscious recall and effort. In the *autonomous stage*, the steps involved to perform the activity eventually become routine.

Applied specifically to DGBL, Automaticity Theory can explain how learning in games may be effective in comparison to traditional teaching. Case in point: consider how reading skills are taught in a traditional classroom. A teacher may first review each of the 26 letters in the English alphabet, allow for practice, and then coach students appropriately until mastery is achieved over time. Unfortunately, the rate at which students learn to read varies between individuals. This may be due to a variety of pre-existing factors such as a student's foundational level of understanding, the primary language spoken in a learner's home, and the practice opportunities afforded to each student.

DGBL can respond more appropriately to this variance: a game can provide options for students to begin in different chapters and provide different starting points depending on what information is needed for each learner. A game can also structure information in a consistent manner so students can identify gaps in their knowledge without missing important steps. Finally, a game can provide reliable one-on-one practice opportunities that allow students to rehearse trickier words until mastery is acquired and reading becomes automatic. In fact, one of the main advantages to digital games is that they allow for replayability and practice; although a student is unlikely to hear the same lesson twice, students can receive repeated exposure to practice in a digital game (Dunbar et al., 2013).

Thus, Automaticity Theory is valuable to apply in explaining the educational benefits of DGBL in the context of learning new skills. Additional research similarly explains that expertise is often best gained through deliberate practice (Ericsson, Charness, Feltovich, & Hoffman, 2006). Digital games are fundamentally designed to follow the structure of Automaticity Theory. First, games begin with a tutorial designed to teach players how different commands are performed (encoding stage). Next, games allow players to progress by putting into practice their learned skills and this process requires deliberate attention at first (associative stage). Finally, when a player nears the end of a game, the skills required to play are mastered and become automatic (autonomous stage).

Cognitive Load Theory. The second cognitive theory covered in this review is the *Cognitive Load Theory* (Sweller, 1988, 1994; Sweller, Ayres, & Kalyuga, 2011). The main premise of Cognitive Load Theory is that, because the human brain can only process a limited amount of information at one time (Baddeley, 1992; Lang, 2006, 2014), the ways in which we receive and process information must be balanced for learning to occur. Mayer (2014a) explains the three types of processing that may impact learning: (1) extraneous; (2) essential; and (3) generative. *Extraneous processing* refers to information that is not related to the actual learning content: it is considered extra information. *Essential processing* refers to the specific learning material and content itself. *Generative processing* refers to the deeper reflective thinking that occurs from truly understanding a concept. Because the human brain has a limited capacity to process information concurrently (Baddeley, 1992; Lang 2006, 2014), too much of any type of processing may create problems in selecting, organizing, and integrating newly learned knowledge.

Within the context of DGBL, extraneous processing can cause a learner to be distracted by superfluous information (Mayer, 2014a). Flashy graphics, an overwhelming narrative, or additional text on the screen may all provide too much irrelevant information that overloads the cognitive system. Essential processing instead enables learners to take in the necessary details to understand the content appropriately. However, essential content by itself can appear dull to learners if not accompanied by material that motivates students to engage. If extraneous variables motivate a learner to take in content appropriately, generative processing then allows students to think more deeply about the learning experience (Wittrock, 1989).

Cognitive Load Theory is also useful to apply to DGBL. Research shows that several features in games may be distracting and negatively impact learning. For example, asking for advice in a learning game is shown to improve learning scores; however, when advice seeking is paired with competition, learning is negatively affected (Van Eck & Dempsey, 2002). If competition is perceived as a threat, it is more likely to work as a distraction that detracts from learning (DeLeeuw & Mayer, 2011). Similarly, narrative game elements have been shown to enhance learning in some studies (Cordova & Lepper, 1996; Adams, Mayer, MacNamara, Koening, A, & Wainess, 2012), but an extraneous narrative device may run the risk of distracting users from learning content as well (Rowe, Shores, Mott, & Lester, 2010).

Though distractions can potentially impact learning in any environment, this is especially the case in games. Entertainment games are designed to utilize showy graphics, immersive stories, and challenging gameplay. In DGBL, these features may provide motivation to engage in the game, but they may also overload cognitive processes and make learning more challenging (Dunbar et al., 2013). As such, the goal of a good learning game is to reduce distracting features (extraneous processing), present information clearly (essential processing), and motivate deeper thinking (generative processing) (Mayer, 2014a).

Best practices. Several studies provide a foundation in establishing what is known regarding what features are more effective in digital training games. After performing a comprehensive literature review examining empirical research on DGBL, Mayer (2014a) identified the features of games that contributed to the most significant positive impacts on learning (with effect sizes greater than $d = .5$). From these, the following five best practices are outlined: (1) appropriate modality utilizations; (2) personalization features; (3) pre-trainings; (4) coaching feedback; and (5) opportunities for reflective self-explanations. In this review, these best practices are further explained and supported with additional studies.

Appropriate modality. The first best practice that researchers can follow when constructing a game for learning is to appropriately consider modality. Modality refers to the type of sensory channel that is used to deliver information to the receiver (Eveland, 2003; Mayer, 2014a). For example, DGBL studies show that students learn more when information is provided by spoken words as opposed to when students read information via text (Moreno, Mayer, Spires, & Lester, 2001; Moreno & Mayer, 2002). This is likely because people have a limited ability to process and store information (Lang, 2000). Because digital games provide a large amount of information through the visual sensory channel (e.g., text, images, movement, etc.), this channel can become easily overloaded. When an abundance of text must be processed visually, this may become too cognitively taxing and it may detract from learning (Mayer, 2014a). Thus, delivering information using a variety of channels (i.e., balancing visual and auditory information to reduce cognitive overload) is particularly important in enhancing DGBL.

Personalization. Second, features of personalization positively impact DGBL. Personalization refers to the degree that a game presents messages in a way that invokes a higher interest or perceived value for the individual player (Wouters & van Oostendorp, 2017). This is akin to the idea of person-centeredness in which a message is adapted to the goals and needs of the individual (Miller, 1978; Waltman, 2002). Personalization features added to DGBL, such as integrating a student's name within the game (Cordova & Lepper, 1996), following politeness norms so characters appear friendlier (Wang et al., 2008), and using a conversational style as opposed to a more formal communication style (Moreno & Mayer, 2000; 2004) contribute to significant learning improvements in comparison to control groups. Though personalization is also effective in face-to-face teaching, this is especially needed for DGBL: when a student interacts with a computer rather than a person, they may perceive the computer as a cold and impersonal teaching tool. Instead, personalization features in DGBL make the experience seem more like the student is interacting with a social partner.

Pre-training. Third, pre-training can further enhance DGBL. Studies show that providing a tutorial designed to teach users a specific topic before a game-based training (e.g., how to play the game itself or foundational content material) results in higher learning (Fiorella & Mayer, 2012; Leutner, 1993; Mayer, Mautone, & Prothero, 2002). Similarly, students can perform better in digital games when the level of challenge in a learning game begins at a low level and then increases in difficulty as students gain new knowledge (de Jong et al., 1999; Swaak, van Joolingen, & de Jong, 1998). Charsky and Mims (2008) explain that users may need additional time early on when learning the controls, the content, and the purpose of playing a computer game to best promote learning. If this material is presented in a manner that is least cognitively taxing, students can build their knowledge as they progress. Therefore, providing learners with a solid pre-training can allow students to better build upon their existing knowledge and produce greater understandings.

Feedback. Fourth, providing students with timely feedback can enhance their learning. DGBL is especially suited to facilitate this goal as individualized feedback can be given to students immediately (Erhel & Jamet, 2013). Immediate explanatory feedback has been shown to positively impact student learning when given throughout a learner's gameplay (Cameron & Dwyer, 2005; Erhel & Jamet, 2013; Mayer & Johnson, 2010). However, if feedback is combined with competitive features, it can lead to less student learning (Van Eck & Dempsey, 2002). Feedback may also contribute to inconsistent findings if it appears invasive and interferes with flow experiences. According to Csíkszentmihályi (1990), *flow* refers to a focused experience in which a person is completely immersed in a task. To prevent interfering with a student's focus in DGBL tasks, feedback in games is best delivered in a non-invasive manner to assist students when they are struggling rather than providing learners with too much feedback (Kickmeier-Rust, Marte, Linek, Lalonde, & Albert, 2008).

Reflection. Lastly, allowing opportunities for students to reflect and explain what they have learned is also an effective practice that enhances DGBL. Research shows that when students are encouraged to explain their decision-making process when playing digital games, students perform better overall on outcome measures related to learning (Bagley & Shaffer, 2015, Fiorella & Mayer, 2012; Lee & Chen, 2009). This does not only apply to situations when students provide their own explanations, but studies show that students also learn more when they are prompted to choose from a list of pre-generated possible explanations for a solution (Mayer & Johnson, 2010; Johnson & Mayer, 2010). This likely performs a function that allows generative thinking to occur through the process of reflection, which may help students to better integrate new knowledge into their existing knowledge structures.

Challenges. These five best-practices showcase features of DGBL that are most effective thus far; more importantly, they represent a body of research that utilizes rigorous empirical testing, appropriate experimental designs, controlled manipulations, and comparison groups. As such, conclusions drawn from this body of research are likely to have high internal validity. Unfortunately, research on digital games is not always so easily controlled in experimental manipulations. Digital games inherently produce different experiences for different users: thus, a variety of confounds may be introduced to studies examining the impact of DGBL. In this vein, this review focusses on two specific problematic themes within DGBL research: problems of unequal comparisons and transfer.

Unequal comparison problems. One issue in DGBL research is the problem of unequal comparison groups (Honey & Hilton, 2011; Randel et al., 1992; Vogel et al., 2006). This issue comes in a variety of forms including studies that (1) compare dissimilar media; (2) compare dissimilar gaming experiences; (3) utilize insufficient control groups; and (4) lack control groups. Each of these issues shares with it the larger problem that digital games are not easily comparable to other types of media, even media that contain similar content. For example, learning that takes place in a digital game, as opposed to a video or textbook, may vary in the types of images presented, the interactivity allowed, extra practice opportunities, and more time afforded to the user. Because most games are designed to give players agency and freedom (Boyle et al., 2011), users may have completely different experiences even when playing the same game. Thus, a variety of confounds are introduced in DGBL research, which makes it a challenge to accurately assess what features of a game contribute to different levels of learning in comparison to other types of training. These problems contribute to an issue with the internal validity of research designs in DGBL.

Transfer problems. A second issue in DGBL research is the problem of transfer. Gamers spend much of their time learning how to play the game itself; they can become skilled in reacting to fast-paced encounters, they develop strategies to conquer other players, and they may develop social skills to collaborate with strangers. However, it is not known if these learned behaviors can transfer to real world skills and abilities. Instead, they may function only within the context of the specific game. Although schema theory (Anderson & Pearson, 1984) suggests knowledge and skillsets should transfer from one type of situation to another, theories of situated learning argue that people learn best by doing the actual behavior in realistic contexts (Shaffer, 2012). Research in this area suggests that cognitive skills in games can transfer to knowledge tests given outside the gaming context (Basak, Root, Vos, & Kramer, 2008), but it is still unknown whether learned cognitive skills can be applied to real life situations. These problems contribute to an issue with the external validity of research designs in DGBL.

Methods. Given these two primary issues in video game studies, researchers must clearly think through the processes of their proposed method in any investigation on DGBL to best identify and become aware of potential issues. Although the potential for confounds and the question of whether learning from a game can be transferred to real life experiences both pose inherent problems to internal and external validity in studies on DGBL, scholars can reduce these issues by applying methods appropriately and addressing the potential for these issues with transparency. In this vein, Mayer (2014a) categorizes the 3 most commonly utilized methods used to explore DGBL: (1) the value-added approach; (2) the cognitive consequences approach; and (3) the media comparison approach. Although this dissertation utilizes a media comparison approach specifically, the first two approaches are also reviewed to provide context regarding the different types of study designs used in DGBL research more broadly.

Value-added. In the *value-added* approach, scholars use serious games that are paired with controlled manipulations to examine what features specifically lead to improved levels of learning when comparing manipulated games to the control versions of the same game. This category is aptly named: by manipulating just one feature in a game and comparing outcomes between games that are otherwise identical, we can best isolate which variables add value to learning and reduce the potential for confounding variables. Thus, scholars using the value-added approach are most likely to infer causality. A variety of studies draw upon the value-added perspective (Adams, Mayer, MacNamara, Koenig, &

Wainess, 2012; Erhel & Jamet, 2013); in fact, much of the research that informs the best practices in DGBL previously noted, consists of studies in this vein.

Cognitive consequences. In the *cognitive consequences* approach, scholars typically examine off-the-shelf games to examine the quality of learning that can be gained from playing them. To examine the learning that takes place after exposure to a digital game, researchers allow users to play the game for a time and then they assess the effects of playing the game. A variety of popular entertainment oriented-games are already associated with educational value (Breuer & Bente, 2010). Popular franchises such as *Assassin's Creed, Call of Duty,* and *Civilization* provide users with a first-person experience in different historical time periods. Thus, these types of games allow learners to test alternative versions of history (Mejia, 2017; Squire & Jenkins, 2003). Much research posits that entertainment games can be harnessed as teaching tools that motivate students and facilitate teachable moments (Charsky & Mims, 2008). Within this domain, scholars can examine whether games like first-person shooters contribute to better reflexes or whether games that simulate history teach accurate knowledge and facts about a specific era.

Media comparisons. In the *media comparison* approach, scholars examine whether the learning that occurs after a DGBL experience contributes to higher or lower levels of learning in comparison to other types of educational media such as textbooks, lectures, or videos. Because digital games often vary in more than one feature in comparison to other types of media, the possibility for confounding variables is an issue scholars must be aware of in this area of research. However, a media comparison approach still offers a meaningful contribution because if researchers can show that digital games are more effective than other more traditional types of educational media, this adds empirical support to rhetoric that already suggests that games should be included in formal school systems (Mayer, 2014a).

The main experiment in this dissertation is designed (at least in part) to follow a media comparison approach to DGBL research. As mentioned previously (Chapter I), this study tests a new deception detection digital learning game called VERITAS. To assess the effectiveness of VERITAS as a teaching tool, this study is designed to compare VERITAS to a more traditional type of training condition: a PowerPoint (PPT) lecture condition. Because this dissertation acknowledges the potential challenges associated with media comparison research, this study also employs Eveland's (2003) mixed attributes framework as an approach to studying media effects in research designed to compare two different types of media. In this way, learning from digital games can be conceptualized as a type of "media effect" to specifically explain what features of different media impact learning.

According to Eveland (2003), research on media effects more broadly faces two problematic issues: (1) no clear conceptualization of the term "mass media effects" exists; and (2) studies on media effects do not always clearly explicate the nuanced differences between various types of mass media tools. Given these issues, Eveland (2003) proposes a nuanced framework that scholars can use to more specifically analyze media effects: the mixed attributes approach. In McLuhan's (1964) well-known axiom, "the medium is the message," he purports that the vehicle used to deliver a message can have a substantial impact itself on message perceptions and the information processing of that message. This truism speaks to the issue at hand: it provides a lens for comparing media effects that can occur as a direct result of the type of medium used to transfer the message (Detenber & Lang, 2010). This can be applied to examine media that vary, but feature the same content.

The mixed attributes approach proposes a framework to conceptualize, explicate, and compare media to better understand the underlying mechanisms that impact effects due to differences between types of media. This is accomplished in two main ways. First, quantitative assessments are used to compare the ways in which each medium varies according to potential attributes; such as interactivity, organization, control, channel, textuality, and content. Second, the ways in which the media differ on each attribute are examined as a group rather than as one component (e.g., videos are low in interaction and low in control; in comparison to games which are high in interaction and high on control). Utilizing a mixed-attributes approach, scholars can better identify the precise ways in which media differ to better isolate and understand the potential for confounds.

This study focuses on four specific attributes proposed by Eveland (2003): (1) the degree of textuality; (2) the type of channel; (3) the degree of interactivity; and (4) the degree of control. *Textuality* refers to the amount of text or textual symbols that are present in different types of media. *Channel* refers to the type of sensory channel that is activated in the media experience (e.g., touch, taste, sight, smell, and sound). *Interactivity* refers to the extent that the medium allows for feedback and response from participants (Eveland, 2003; Newhagen & Rafaeli, 1996). *Control* refers to the ability that users have in exercising free-will in their consumption of the media. The concepts of interactivity and control overlap, yet remain distinct: whereas interactivity refers to a user's ability to participate and affect the medium, control refers to the degree that a user can impact the pausing and pacing of media tools (Eveland, 2003; Eveland & Dunwoody, 2001). In this dissertation, a fifth attribute is added to also explore differences in *time;* (5) time refers to the number of consecutive minutes that users are likely to spend engaged in a medium per specific session of use.

By examining each of these five attributes (textuality, channel, interactivity, control, and time) for both media tools compared in this study (VERITAS the training game vs. PPT training lecture) we can better categorize the differences between each platform. Both VERITAS and the PPT lecture are explained in more detail in later chapters (see Chapter IV for VERITAS and Chapter V for PPT). Nonetheless, Table 1 uses Eveland's (2003) mixed attribute approach to summarize the ways these two media differ. Although the training content between the two educational tools is comparable, the PPT training relies primarily on textual words, narration, and few pictures, it offers no ability for users to interact with or control the pacing of the lecture, and it is relatively short; thus, PPT offers a high degree of textuality, a low degree of engagement with additional sensory channels, a low degree of interactivity, a low degree of control, and a low degree of time.

In comparison, VERITAS relies on a combination of textual words, narration, an abundance of pictures, full motion video recordings featuring actors, the ability to interact by choosing dialogue points, the ability to pause and move forward more easily, and it is relatively long; thus, VERITAS offers a high degree of textuality, a high degree of engagement with additional sensory channels, a high degree of interactivity, a high degree of control, and a high degree of time. This comparison provides a foundation for asserting that these two media are different in multiple dimensions and it begins to explain how they differ so researchers can better understand what attributes drive the specific variations.

Table 1

Summary of Media Attributes for PPT vs. VERITAS

Medium	*Textuality*	*Sensory Channel*	*Interactivity*	*Control*	*Time*
PPT	High	Low	Low	Low	Low
VERITAS	High	High	High	High	High

Summary. In summary, this first section of the literature review was designed to explicate how learning occurs in digital games. Automaticity Theory and Cognitive Load Theory were both explained as a lens to demonstrate the pedagogical features of DGBL. Five best practices (modality, personalization, pre-trainings, feedback; self-explanations) and two challenges (problems of unequal comparisons and problems of transfer) were reviewed to show what features are more effective in DGBL and what issues impact studies on video games more broadly. Finally, the most common methods that are used to assess games were reviewed and a media comparison approach was applied to examine differences between VERITAS and the PPT lecture that are used in this study.

As discussed previously, the goal of a good learning game is to reduce extraneous processing, promote essential processing, and motivate generative processing (Mayer, 2014a). Based on decades of research on video game effects, there is much that we know regarding the positive cognitive (Dunbar et al., 2013) and social impacts of games (Greitemeyer & Osswald, 2010). Given (1) the advocacy for digital games reviewed previously, (2) the positive effects associated with digital games, and (3) the higher scores reported for the game-based training according to Eveland's (2003) mixed attributes (sensory channel, interactivity, control, and time), it would be reasonable to suspect that users may learn more in the VERITAS training game condition in comparison to a PPT video lecture condition. As such, the following hypothesis is proposed in this study:

> **H_1:** In comparison to users who watch a PowerPoint training lecture, users who play a digital training game will exhibit greater learning in deception detection knowledge.

Explicating Motivation in Digital Games

The review thus far explains how learning broadly functions in digital games. Beyond these previously reviewed general learning processes, scholars also explain one specific reason why digital games are likely to function as effective educational tools: scholars hypothesize that digital games may positively impact user motivation to learn (Gee, 2007). In the next part of this review, the literature is divided into the following three key areas of research: (1) general human motivation; (2) motivation in the specific context of learning; and (3) motivation to play digital games.

Human motivation. Scholars conceptualize human motivation using both broad and specific definitions. More broadly, *Motivation* refers to an initiating psychological force that drives human behavior (Bigge, 1984; Touré-Tillery & Fishbach, 2014). It generally refers to a persons' level of energy including their inclination toward completing a task such as learning, working effectively, and achieving to one's full potential (Martin, 2014).

More specifically, Touré-Tillery and Fishbach (2014) posit that motivation can be divided in two primary dimensions: (1) *outcome-focused* motivation (i.e., the drive to complete a goal); and (2) *process-focused* motivation (i.e., the drive toward attending to the process of completing a goal). The process-focused dimension of motivation can be further divided into two additional categories: (3) *means-focused* motivation (i.e., the drive toward using proper methods in the process of completing a goal) and (4) *intrinsic* motivation (i.e., the drive toward enjoying the process of completing a goal). Each dimension can play a role in influencing the degree a person is motivated to perform a task. Because motivation is a psychological process that occurs within the individual, observing and recording levels of motivation requires careful consideration. Touré-Tillery and Fishbach (2014) describe the four most common approaches used to measure aspects of human motivation: cognitive, affective, behavioral, and physiological.

First, c*ognitive* measures are used when examining how goals are organized in one's associated memory in relation to other similar constructs. Tests of recall are often used to examine this relationship: if a learner is taught 10 new vocabulary words and he or she can recall all 10, then this indicates a higher level of motivation to do well in the activity (an *outcome-focused* motivation). The assumption underlying this form of motivation is that completing a task successfully inherently implies a higher level of motivation.

Second, *affective* measures are used when examining a participant's subjective evaluations in relation to a goal. To examine subjective evaluations, researchers can ask participants to complete self-report measures to describe their experiences or they may utilize implicit association tasks. If a participant evaluates a task positively, this indicates a higher level of motivation (*process-focused* motivation; *intrinsic* motivation).

Third, *behavioral* measures examine a person's observable actions during the process of completing a goal and the degree to which the action matches the most appropriate type of behavior for the task. For example, if a learner is required to answer at least 5 out of 10 questions, but the learner answers all 10 questions, this indicates higher motivation (*process-focused motivation*; *means-focused* motivation). Finally, *physiological* measures are used to examine a person's physical response to stimuli, which may be able to indicate the degree a person is motivated to perform a related behavior.

Much research examines outcome-focused and process-focused motivation. *Self-Determination Theory* (SDT; Ryan & Deci, 2000) claims that motivations are enhanced or inhibited by the potential for extrinsic or intrinsic rewards. Extrinsic rewards refer to externally desirable factors (such as praise or profit; *outcome-focused* motivations) whereas intrinsic rewards refer to internal personal feelings (such as the satisfaction of psychological needs; *process-focused* motivations). At its core, SDT claims that three specific psychological needs are intrinsically motivating: *competence* (i.e., the degree a person perceives efficacy in performing a task), *autonomy* (i.e., the degree a person perceives freedom in performing a task), and *relatedness* (i.e. the degree a person feels connected to others).

Several overlapping constructs are used to assess additional process-focused measures of motivation. McAuley, Duncan, and Tammen (1987) examined user experiences when playing basketball and found that the following variables contribute toward intrinsic motivation: (1) *competence* (as reviewed previously); (2) *enjoyment* (i.e., satisfaction from a task), (3) *effort* (i.e., exertion to perform the task); (4) *pressure* (i.e., stakes or value of the task); and (5) *choice* (i.e., freedom in the task). Similarly, Pelletier et al. (1995) examined the context of sports motivation as well and found that a related set of variables positively influenced process-focused motivation: (1) *knowledge* acquisition (i.e., learning new information about the task); (2) *accomplishment* (i.e., doing the task well); and (3) *stimulation* (i.e., enjoying the experience). Essentially, experiences that are evaluated highly are often positively associated with process-focused motivation.

Motivation to learn. *Motivation to learn* refers to the internal drive toward beginning a learning task and staying engaged in goal-directed behavior (Mayer, 2011; Mayer 2014b). Academic motivation exhibits the following four features: (1) it functions as a *personal* experience within the individual; (2) it requires *activation* toward a learning behavior; (3) it *energizes* a person to maintain the behavior; and (4) it is *directed* toward accomplishing a specific task (Mayer, 2014b). The more motivated a learner is in an academic task, the more likely they will engage appropriately with a learning process.

Researchers conceptualize learning motivation within two contrasting views (Bigge, 1982). In the first perspective, *behaviorists* describe motivation as an instigating force driven by needs, emotions, and conditioning. It implies that an organism is deprived of a stimulus and wants to move toward it (an appetitive response) or is discomforted by a stimulus and wants to move away from it (an aversive response) (Bigge, 1982; Detenber & Lang, 2010). From this perspective, people learn via routine and automatic processes by responding to their internal drives and direct stimuli. For example, Maslow's (1943) hierarchy of needs explains that people are driven to satisfy the following primary needs: (1) physiological needs; (2) safety; (3) belonging; (4) esteem; (5) and self-actualization. Therefore, individuals may be inherently driven toward learning tasks that allow them to satisfy these primary needs.

In an alternative perspective, *cognitive psychologists* (also known as *gestalt*) view motivation as a force that arises from an individual's goals, expectancies, intentions, and purposes. Rather than viewing motivation as a drive to satisfy an impulse triggered by stimuli, it arises from a person's psychological situation and is characterized by the desire to do something (Bigge, 1982). From this perspective, people need to be encouraged to learn and teachers must help students to understand the importance of learning. Therefore, individuals may be inherently driven toward learning tasks that satisfy unique purposes.

Rather than viewing motivation from either a dichotomized behavioristic or cognitive perspective, it is likely most useful to conceptualize learning motivation as a combination of both frameworks. That is, motivation is likely driven in part by needs, emotion, and stimuli; but an individual's goals and intentions ultimately play a role in influencing a learner's specific level of motivation. Because individual differences drive needs, emotions, goals, and intentions, learners are not equally motivated by the same subjects, tasks, or activities. According to McCormick and Pressley (1995):

> Students are not always motivated to learn more or to use what they know already. Some do just enough to get by instead of using every opportunity to learn all they can. Others stop making any attempt to succeed academically altogether. If we wish to create good thinkers, we need to understand academic motivation better and to consider new ways of structuring schooling to enhance rather than destroy academic motivation (p. 30).

Put simply, pre-existing attributes, factors, and demographics related to a person's unique psychological perspective or persona may influence a user's subsequent motivation. For example, differences in motivation have been shown between sexes with females indicating more motivation to perform well in tasks in comparison to males (Martin, 2007; Thomson et al., 2010). Recent research also shows that a person's racial-cultural identity can play a role in influencing their level of motivation in ways that have been previously ignored in modern theoretical considerations (DeCuir-Gunby & Schutz, 2016).

It has only been in recent investigations that scholars have begun to examine the impact of an individual's unique level of motivation and how motivation may function differently across different types of people (Corno, 2016). Still, motivation is also influenced by the types of learning tools afforded to students: studies show that integrating tablet technology into classroom learning experiences broadly increases both student engagement and motivation for learners (Blackwell, 2013; Lemke, Coughlin, & Reifsneider, 2009; Melhuish & Falloon, 2010). Thus, motivation to learn is likely impacted by both broad considerations, such as the learning context, and by individual characteristics more specifically, such as a users' demographics, attributes, and attitudes. In this vein, it is likely that individual pre-existing factors may impact learning in games as well.

Motivation in digital games. Modern reports show that approximately 65% of U.S. households own video game playing devices. The average age of players is 35 years old and player percentages are composed of both females (41%) and males (59%). 52% of frequent players find video games to provide more value than DVDs, music, or going to the movies (Entertainment Software Association, 2016). Empirical studies also indicate that gamers spend a substantial amount of time playing video games (Van Looy, Curtois, & De Vocht, 2014; Williams, Ducheneaut, Xiong, Yee, & Nickell, 2006; Williams, Yee, & Caplan, 2008) with reports of extreme cases indicating that some users play 80 hours per week (Williams, 2006). This implies that digital games may influence a spectrum of motivations from light general play to more extreme playing. Research seeks to explain what motivates people to play video games across this spectrum.

Self-Determination Theory (SDT; Ryan & Deci, 2000), as reviewed previously, is one popular model that is useful in explaining why people play video games. As mentioned previously, SDT claims that people are motivated by extrinsic and intrinsic needs and three specific psychological needs are especially intrinsically motivating: competence, autonomy, and relatedness. A variety of intrinsic and extrinsic needs can be satisfied through digital games. The intrinsic need for relatedness is often satisfied through multiplayer games (Longman, O'Connor, & Obst, 2009; van Rooij, Schoenmakers, van den Eijnden, Vermulst, & van de Mheen, 2014). When users play video games to satisfy autonomy and competence, players can repair negative mood states (Reinecke et al., 2012). Similarly, players can sometimes satisfy extrinsic needs by trading in-game resources and items for real-world money (Keegan, Ahmad, Williams, Srivastava, & Contractor, 2011). Players can also participate in video game tournaments to compete for lucrative, real-world rewards (Taylor, Jenson, & de Castell, 2009; Taylor, 2012).

Given the appeal of video games to help satisfy intrinsic and extrinsic motivations, scholars suggest that digital games may be suitable to also motivate students to learn. In this regard, Gee (2007) posits that:

> In an 'attentional economy,' where diverse products and messages, not to mention school subjects, compete for people's limited attention, video games draw attention in a deep way. It is clearly a profoundly important subject for research to understand the source or sources of this motivation. Such motivation is clearly foundational for learning (p. 152).

Indeed, research on digital games suggests that the lure of game play may motivate an assortment of positive behaviors in tasks that users may not ordinarily be inclined to perform. For example, augmented reality games have been shown to motivate users to increase their physical activity in games like *Pokémon Go* (Althoff White, & Horvitz, 2016) and they have the potential to encourage users to get more involved in practicing civic engagement activities such as participating in the stewardship of projects designed to improve local parks (Coulter, Klopfer, Perry, & Sheldon, 2012).

Although digital games may motivate users to engage in behaviors that they might not otherwise be inclined to perform, motivation remains a complex concept in DGBL. In a meta-analysis performed by Wouters and van Oostendorp (2017) 50 studies were reviewed to assess the effectiveness of learning in digital games (with 17 articles on motivation in DGBL specifically). This meta-analysis reviewed studies from a value-added perspective to examine games that used instructional techniques in comparison to games without the same instructional techniques. Instructional techniques were defined as "any adaptation of a feature of the game itself or in the context of the game that influences the selection of relevant information, the organization, and integration of that information" (p. 1).

Out of nine instructional techniques examined (adaptivity, collaboration, content integration, context integration, feedback, level of realism, modeling, narrative, and reflection), all were shown to enhance learning; with the one exception of the narrative technique. On the other hand, only three of these instructional techniques were shown to improve user motivation: content integration, level of realism, and narrative elements. In other words, findings for motivation generally show that serious games with instructional techniques are significantly more motivating for users than serious games without instructional techniques (effect size, $d = .26$; Wouters & van Oostendorp, 2017). This meta-analysis shows the complex relationship between motivation and game-based learning and indicates that motivation can be enhanced by providing more effective instructional techniques.

In related research, Rodríguez-Aflecht, Hannula-Sormunen, McMullen, Jaakkola, and Lehtinen (2016) further examined motivation and learning in the context of a digital math training game. They compared outcomes between students who chose not to play a math game (no play, *n* = 242); those who chose to play the math game (voluntary play, *n* = 337); and those who were required to play the math game as a component of their regular classroom lessons (required play, *n* = 482). Findings show that students who played the game (both voluntarily and required) performed better than students who opted not to play the math game. However, students in the required-play condition unexpectedly played for longer, completed more tasks, and enjoyed the game more. The authors speculate that students may have preferred the game in the required-play condition because they compared it to their regular classroom mathematics lessons, which were likely not as engaging as the game.

Larger findings of this study suggest important considerations regarding motivation in digital games. Those who were required to play the game and those who played the game freely on their own time were equally motivated to play, while students who chose not to play scored lower on posttest measures of gaming interest, gaming self-efficacy, and math self-efficacy (Rodríguez-Aflecht et al., 2016). This suggests that some motivational aspects, such as interest and efficacy, are lower for people who choose not to play DGBL. Thus, people who are not as motivated to play digital games are not likely to receive the advantages that may be associated with learning from digital games.

In summary, the research on digital games and motivation is currently at a nascent stage of development. Although advocates claim that video games may be inherently motivating and evidence exists showing that games can encourage some users to engage in directed tasks, this may only be the case for users who are already interested in video games or the task at hand. But when examining motivation in games and simulations specifically, research in this area is mixed (Rueda, O'Neil, & Son, 2016). Calling for more research in this area, Mayer (2009) posits that, "motivation is an important part of a complete theory of multimedia learning – as can be seen in the attraction of video games, for example – so research is needed on how motivation works in multimedia learning" (p. 280). In response to this and other similar calls, this dissertation examines the ways that individual differences impact motivation to explain the context in which learners are more likely to find games motivating.

Student-Centered Theories

Although games may be motivating for some users, it would be a mistake to assume that digital games are always sufficiently motivating for all types of learners. In fact, there may be certain contexts and conditions in which some people may be more motivated to learn from a game compared to others. Several theories make predictions regarding how student-centered factors (SCFs) may influence motivation in general learning contexts. These SCFs are briefly reviewed and clustered in the following groups: (1) interests; (2) beliefs; (3) goals; (4) needs; (5) and pre-existing knowledge. Finally, these theories also inform the remaining hypotheses tested in this dissertation.

Interests. Research indicates that when students are interested in a topic, they are more motivated to learn (Hidi, 2001; Pintrich, 2003). Two theories explain this phenomenon: *Interest Theory* and *Expectancy Value Theory*. The main premise of Interest

Theory (Dewey, 1913) is that people will put more effort into learning a topic if the material is interesting and relevant. Similarly, Expectancy Value Theory (Wigfield, Tonks, & Klauda, 2009) purports that people will work harder if they value the work they are doing. Because games are typically considered to be a source of entertainment and fun, students may be naturally interested in playing games and find them interesting and valuable. Thus, games may provide a compelling vehicle to deliver course content if they suitably capture student interests and values.

Unfortunately, turning a training into a game does not necessarily make the experience interesting or valuable for all learners. Critiques of DGBL liken this phenomenon to the idea of adding *chocolate* to *broccoli* in that the chocolate (a game) does not actually transform the broccoli (training) in any meaningful way (Chen, 2016). Attempting to add something interesting to an otherwise boring topic is called *situational interest* and forcing interest artificially in academic content may be an ineffective strategy (Dewey, 1913).

Still, theories on student interests provide a useful launching point for considering why students may be motivated to engage in DGBL. A study that examines how a subject's pre-existing perceptions (such as student interests) may predict their experience playing a learning game can contribute much to the literature in helping researchers better understand the relationship between student interests, learning, and motivation in games. Similarly, a student's level of interest in the learning topic in this study, deception detection, may also predict learning outcomes and motivation.

As mentioned previously, motivation can be measured in a variety of ways. Touré-Tillery and Fishbach (2014) outlined two primary dimensions: (a) *outcome-focused* motivation and (b) *process-focused* motivation. The process-focused dimension of motivation can be further divided in two additional categories: (c) *means-focused* motivation and (d) *intrinsic* motivation. This study examines the impact of student interests on each of these four types of motivation. Based on the prior literature on DGBL, motivation in learning, and student interests, the following hypotheses are put forth:

> **H_2:** For users playing a training game, higher interest in digital games will predict higher scores on outcome measures of: (a) outcome-focused; (b) process-focused; (c) means-focused; and (d) intrinsic motivation.

> **H_3:** For users playing a training game, higher interest in deception detection will predict higher scores on outcome measures of: (a) outcome-focused; (b) process-focused; (c) means-focused; and (d) intrinsic motivation.

Beliefs. The beliefs students hold regarding their ability to perform well in school impact their motivation and subsequent behavior to actually perform well (Schunk, 1989; Schunk & Pajares, 2009). Two theories explain this phenomenon: *Self-Efficacy Theory* and *Attribution Theory*. Self-Efficacy Theory (Bandura, 1977) states that if a person thinks they are capable in performing a task, they will be more likely to persevere and keep trying until it is accomplished. Similarly, *Attribution Theory* (Kelley 1967; Kelley & Michaela, 1980) purports that people seek to apply explanations to "better" understand people, behaviors, and events. The ways we attribute meaning to each of these phenomena can impact the ways we subsequently behave. People make both internal or external attributions: internal attributions refer to a person's characteristics, traits, and abilities, whereas external attributions refer to forces exerted outside the person that influence their behaviors.

Research shows that students try harder when they attribute both successes and failure to their own internal abilities (Borkowski, Weyhing, & Carr, 1988). Taken together, these theories tell us that if a person believes they can accomplish a task, they will try harder to do so. This line of reasoning is especially useful to consider in the context of learning when some students may have lower expectations regarding their ability to succeed.

Theories about student beliefs are important to consider in relation to DGBL. Because games have existed for decades, students have already developed pre-existing beliefs regarding their ability to do well in a game and their ability to enjoy a game experience. Because many students may already play and enjoy games, it is reasonable to expect that they may be motivated to engage in DGBL if they have positive expectations regarding their ability to perform in games (Mayer, 2014a). Unfortunately, the reverse may also be true. Many students may have negative experiences interacting in games. They may also believe that games are only associated with negative behaviors such as addiction (Lemmens, Valkenburg, & Peter, 2009), violence (Smith, Lachlan, & Tamborini, 2003), aggression (Weber, Ritterfeld, & Mathiak, 2006), and antisocial tendencies (Anderson, 2004). Therefore, these users may be less motivated to learn from a video game than others.

Researchers must consider student pre-existing beliefs about games when assessing whether games are effective in DGBL. Similarly, student beliefs regarding one's ability to understand the learning content in this study, deception detection, should also be considered. This study examines the impact of student beliefs on the previously outlined four types of motivation. Based on the prior literature on DGBL, motivation in learning, and student beliefs, the following hypotheses are put forth:

> **H_4:** For users playing a training game, a stronger belief users can learn from digital games will predict higher scores on outcome measures of: (a) outcome-focused; (b) process-focused; (c) means-focused; and (d) intrinsic motivation.

> **H_5:** For users playing a training game, a stronger belief users can learn about deception detection will predict higher scores on outcome measures of: (a) outcome-focused; (b) process-focused; (c) means-focused; and (d) intrinsic motivation.

Goals. Student goals may also impact motivation and learning behaviors (Erhel & Jamet, 2013). One theory that explores this concept is *Goal Orientation Theory* (Maehr & Zusho, 2009). This theory purports that when students engage in a learning experience, their goals ultimately play a role in their motivation to perform. The theory examines three different types of goals: (1) performance-approach, (2) performance-avoidance, and (3) mastery. An approach goal is one in which students wants to show others that they can perform well. An avoidance goal is one in which a student wants to avoid showing others that they may perform badly. The mastery goal is one in which a student simply is motivated to learn and perform well regardless of the outcome. Students who have a mastery-oriented or approach-oriented goal are more likely to perform better in comparison to students who have an avoidance goal (Maehr & Zusho, 2009).

In the context of DGBL, goals are an important consideration. Games feature numerous opportunities to show others how well one can achieve or how poorly one may perform. Many entertainment games utilize achievement systems such as leaderboards (Christy & Fox, 2014) and badges (Grant & Betts, 2013) that are designed to display one's level of accomplishment to others. Mayer (2014a) purports that students who begin with a performance-approach to games may eventually adapt their goals to become mastery-oriented.

Therefore, students who utilize either approach or mastery-oriented goals are more likely to thrive in a game that provides an opportunity to showcase achievements. Although both goals are likely to positively predict motivation, they each function in distinct ways and it is worth testing how they individually function. On the other hand, students with a performance-avoidance approach may withdraw from games or develop a fear of failure if they believe they are performing poorly and if their poor performance levels are displayed to others (Erhel & Jamet, 2013). This study examines the impact of student goals on the previously outlined types of motivation. Based on the prior literature on DGBL, motivation in learning, and student goals, the following hypotheses are put forth:

H_6: For users playing a training game, stronger approach-oriented goals will predict higher scores on outcome measures of: (a) outcome-focused; (b) process-focused; (c) means-focused; and (d) intrinsic motivation.

H_7: For users playing a training game, stronger mastery-oriented goals will predict higher scores on outcome measures of: (a) outcome-focused; (b) process-focused; (c) means-focused; and (d) intrinsic motivation.

H_8: For users playing a training game, stronger avoidance-oriented goals will predict lower scores on outcome measures of: (a) outcome-focused; (b) process-focused; (c) means-focused; and (d) intrinsic motivation.

Needs. Basic human needs can also impact a learner's willingness and motivation to engage in learning tasks. As reviewed previously, *Self-Determination Theory* (Deci & Ryan, 2008) purports that motivations can be enhanced or inhibited by the possibility of extrinsic and intrinsic rewards. Extrinsic rewards refer to external factors (such as praise or reward) whereas intrinsic rewards refer to personal feelings (such as the satisfaction of psychological needs). According to Ryan and Deci (2000), tasks that allow people to satisfy needs of competence, autonomy, and relatedness will be more motivating to pursue.

Research largely indicates that entertainment games allow people to satisfy the need for competence, autonomy (Reinecke et al., 2012) and relatedness (Longman, O'Connor, & Obst, 2009; van Rooij, Schoenmakers, van den Eijnden, Vermulst, & van de Mheen, 2014). When people can satisfy these needs, they feel more enjoyment from games (Ryan, Rigby, & Przybylski, 2006; Tamborini, Bowman, Eden, Grizzard, & Organ, 2010). Similarly, Malone and Lepper (1987) posit that the following four features of games also contribute to intrinsic rewards: challenge, fantasy, curiosity, and control. Because games naturally tap into these four concepts, this provides further evidence that games may be able to satisfy an assortment of individual needs. If DGBL can appropriately satisfy psychological needs, serious games may be inherently motivating to some individuals.

People may also have a need to experience opportunities for "fun." Much research examines the benefits of having fun: studies show an association between pretend play and the desire to participate in fiction (Tooby & Cosmides, 2001), entertainment (Steen & Owen, 2001; Vorderer, 2001), and video games (Murray, 2006). Video games may also function as a form of pretend play, which allows humans to simulate survival-relevant scenarios in low-risk environments (Huskey, Adams, Craighead, & Weber, 2014). Because play and survival-relevant fun is experienced as intrinsically rewarding, play through video games is also likely to be intrinsically rewarding.

Therefore, educational approaches can utilize digital games as a source of structured fun for people of all ages to make knowledge acquisition more motivating (Boyle et al., 2011). Given what is known regarding the potential for video games to fulfil a variety of different types of needs for each individual user, those who perceive video games as a tool that can help them to satisfy their needs are likely to become more engaged when playing a digital training game. Similarly, meeting needs by learning about the relevant topic in this study, deception detection, may also impact motivation. This study examines the impact of student needs on the previously outlined types of motivation. Based on the prior literature on DGBL, motivation in learning, and student needs, the following hypotheses are put forth:

> **H_9:** For users playing a training game, greater indications that digital games can meet their needs will predict higher scores on outcome measures of: (a) outcome-focused; (b) process-focused; (c) means-focused; and (d) intrinsic motivation.

> **H_{10}:** For users playing a training game, greater indications that deception detection can meet their needs will predict higher scores on outcome measures of: (a) outcome-focused; (b) process-focused; (c) means-focused; and (d) intrinsic motivation.

Knowledge. Lastly, a student's existing knowledge on a specific topic impacts their ability to process new knowledge on the same topic. In this vein, *Schema Theory* (Anderson & Pearson, 1984) purports that much of our expertise in any field must first begin with an understanding of the categories and concepts within that field. To build our expertise, we build our schemata first (Mayer, 2009; Sweller, Ayres, & Kalyuga, 2011). According to McCormick and Pressley (1995), schemata are defined as the generalized knowledge-bases we use to mentally organize different objects, situations, and events. Within our schema of classroom settings, we can expect to encounter the same basic phenomena each time we interact in a class: students, teachers, desks, books, papers, and tests. Our schemata serve as abstract understandings of how we organize information into expected categories.

Within a learning context, we typically seek to teach students how to build new schemata, or new ways to organize their knowledge structures within their existing understandings. Therefore, schema theory is useful because it explains how people integrate new knowledge into their existing methods of organizing prior information. Importantly, research shows that our ability to gain new knowledge on a particular topic largely depends on our existing knowledge. Learners with a solid foundation or strong existing schemata are more likely to build upon their existing knowledge to produce greater understandings (Bartlett, 1932; Sweller, 2005).

Therefore, learning is more likely to occur when new information can be merged with existing knowledge. However, when it comes DGBL, not everyone is experienced with playing digital games or feels comfortable learning the rules of a virtual learning experience. Presumably, a user who is already experienced adapting to digital games will be more likely to engage in a new DGBL environment. Similarly, users who perceive that they have a good foundation of knowledge regarding the topic of deception detection may be more capable of taking in new information. This study examines the impact of pre-existing knowledge on the previously outlined types of motivation. Based on the prior literature on DGBL, motivation in learning, and pre-existing knowledge, the following hypotheses are put forth:

H_{11}: For users playing a training game, greater pre-existing knowledge in digital games will predict higher scores on outcome measures of: (a) outcome-focused; (b) process-focused; (c) means-focused; and (d) intrinsic motivation.

H_{12}: For users playing a training game, greater pre-existing knowledge in deception detection will predict higher scores on outcome measures of: (a) outcome-focused; (b) process-focused; (c) means-focused; and (d) intrinsic motivation.

Summary: Student-Centered Factors model. In summary, the following five factors have a theoretical basis regarding why they may impact user learning and motivation: (1) interests; (2) beliefs; (3) goals; (4) needs; and (5) knowledge. As a group, this dissertation uses the term *student-centered factors* (SCFs) to refer to this cluster of pre-existing characteristics. These characteristics cannot be experimentally manipulated; however, they can function as pre-existing predictor variables that may impact how a user ultimately interacts with a learning game. Based on the previously reviewed theoretical considerations, the proposed hypotheses indicate how each SCF is likely to impact motivation in further empirical testing (summarized in Table 2).

Table 2

Summary of Hypotheses

H	Predictions
H_1	In comparison to users who watch a PowerPoint training lecture, users who play a digital training game will exhibit greater learning in deception detection knowledge.
H_2	Higher interest in digital games will predict higher motivation.
H_3	Higher interest in deception detection will predict higher motivation.
H_4	Stronger beliefs users can learn from digital games will predict higher motivation.
H_5	Stronger beliefs users can learn about deception detection will predict higher motivation.
H_6	Stronger approach oriented goals will predict higher motivation.
H_7	Stronger mastery oriented goals will predict higher motivation.
H_8	Stronger avoidance oriented goals will predict lower motivation.
H_9	Greater indications that digital games can meet needs will predict higher motivation.
H_{10}	Greater indications that deception detection can meet needs will predict higher motivation.
H_{11}	Greater pre-existing knowledge in digital games will predict higher motivation.
H_{12}	Greater pre-existing knowledge in deception detection will predict higher motivation.

III. Study I: Pilot Testing

This research was conducted as one part of a larger study that examines learning in digital games, with funding sponsored by the National Science Foundation (NSF; Principal Investigator, Dr. Norah E. Dunbar; *Teaching Bias Mitigation through Training Games with Application in Credibility Attribution;* #1523083). The primary procedures, measures, and data generated for this study were developed in collaboration between research teams located at three separate universities in the western, midwestern, and southeastern United States. In addition to this larger funded project, a separate set of original procedures and measures was developed in tandem to specifically test the proposed hypotheses in this dissertation. Where appropriate, this research summarizes procedures as they occurred in the larger research study; however, the primary focus is to describe the methods, results, and discussion points that apply directly to the dissertation hypotheses of interest.

To examine the degree that pre-existing student-centered factors (SCFs) can be used to predict a person's likelihood of learning and motivation in DGBL, a sequential mixed-methods design was utilized in which both qualitative and quantitative data were gathered in three different data collection stages. Study I (Chapter III) utilized a survey method to pilot test the instrumentation that was designed to measure the five SCFs of interest in this study. Study II (Chapter IV) was exploratory and used both focus group and interview methods to examine participant experiences after play-testing an alpha version of the digital learning game, VERITAS. Study III (Chapter V) used a pretest-posttest experimental design to assess the degree that SCFs impact learning between two types of training conditions and to assess the degree that SCFs predict motivation. Following the method and results for each analysis, a general discussion interprets overall findings.

Method

The goal of study I was to test the effectiveness of a newly developed instrument designed specifically to measure five pre-existing SCFs (interest, beliefs, goals, needs, & knowledge) in relation to their impact on learning in digital games and in relation to the topic of interest in this study (deception detection). A self-administered online survey was used to test the adapted instrument. This instrumentation was analyzed using three criteria (1) inter-item internal reliability; (2) variability between respondent answer choices; and (3) time spent in the survey.

Participants

Volunteer participants (*N* = 64 valid cases) included college students enrolled in a large midwestern United States university. Students received a nominal amount of course credit for participation. Participants included the following demographics: 56.3% females and 43.8% males, with a mean age of 22 years (*SD* = 4.93). Regarding ethnicity, 65.6% were White, 4.7% were Black or African American, 7.8% were American Indian or Alaska Natives, 12.5% were Asian, and 9.4% indicated their ethnicity as "other." In addition, 93.8% reported that English was their first language and 6.3% reported that English was not their first language.

Procedure

Participants completed an online self-administered survey hosted by Qualtrics (approximately 1 hour in length). The survey included the following components: first, a consent form informed participants of procedures and the confidentiality of their data. Next, participants entered a designated ID number used to assign course credit for completion of the study. Participants then completed the following five measures in order: *Experience with Gaming; Student-Centered Factors; Trait Reactance;* and *Outcome Relevant Involvement.*

After these measures, participants completed a *Self-Affirmation Task (with induction check);* and a *Deception Detection PowerPoint lecture training* (described in Chapter V). Following the training, participants completed eight additional measures in order: *Threat to Freedom*; *Negative Affect Reactance; Cognitive Appraisal; Cognitive Absorption; Intrinsic Motivation; Deception Detection Activity Motivation;* and *Outcome Relevant Involvement.* Lastly, participants completed questions about their *Demographics*. As noted previously, this research was completed in tandem with a larger study funded by NSF on learning in digital games. Although these measures were pilot tested in this survey, this dissertation covers the pilot testing of the SCFs instrumentation only (interest, beliefs, goals, needs, & knowledge).

Measures

Student-Centered Factors. A newly developed instrument was created to measure five pre-existing SCFs (interest, beliefs, goals, needs, & knowledge). Each measure was composed of two subscales to examine SCFs in relation to both learning from digital games and the specific learning topic of interest: deception detection (see Appendix A to view the complete measure with all subscales). Because participants in this study were required to complete 12 other measures in addition to the SCF subscales, an effort was made to keep this measure brief with only two items used to form each subscale. The goal of the pilot was to assess if measures composed of only two-items were suitable for further testing.

Student interests. A *student interests* measure was adapted to examine whether students' prior interests predicted learning and motivation. This scale was composed of two subscales: (1) *student interest toward learning in games* and (2) *student interest toward learning deception detection*. Both were measured using 2 Likert-scale items (ranging from 1 – 7; "strongly disagree" to "strongly agree"). An example item from the interest in games subscale includes "I'm interested in learning new information from playing a video game." The reliability was acceptable for the interest in games scale (α = .81, *M* = 4.77, *SD* = 1.63) and approaching an acceptable level for the interest in deception scale (α = .69, *M* = 5.30, *SD* = 1.21). Because the interest in deception scale was only approaching an acceptable reliability, further analysis identified the degree to which the two items in this subscale were correlated: $r = .53$, $p < .001$.

Student beliefs. A *student beliefs* measure was adapted to examine whether students' prior beliefs predicted learning and motivation. This scale was composed of two subscales: (1) *student beliefs toward learning in games* and (2) *student beliefs toward learning deception detection*. Both were measured using 2 Likert-scale items (ranging from 1 – 7; "strongly disagree" to "strongly agree"). An example item from the game subscale includes "I believe I can learn something useful from a video game." The reliability was acceptable for the beliefs about games scale (α = .87, *M* = 4.90, *SD* = 1.66); however, the reliability was unacceptable for the beliefs about deception scale (α = .10, *M* = 5.98, *SD* = 1.03). Because the beliefs in deception scale did not indicate an acceptable reliability, further analysis examined the degree to which the two items in this subscale were correlated ($r = .05$, $p = .67$); the two items were not significantly correlated.

Student goals. A *student goals* measure was adapted to examine whether students' goals predicted learning and motivation. This scale was composed of six subscales: (1) *approach goals toward games;* (2) *avoidance goals toward games;* (3) *mastery goals toward games;* (4) *approach goals toward learning deception*; (5) *avoidance goals toward learning deception;* (6) *mastery goals toward learning deception.* All six were measured using only 1 Likert-scale item (ranging from 1 – 7; "strongly disagree" to "strongly agree"). An example item from the approach subscale includes “My goal when playing a video game is to perform well so others will know how capable I am.”

Student needs. A *student needs* measure was adapted to examine whether student needs predicted learning and motivation. This scale was composed of two subscales: (1) *student needs regarding digital games* and (2) *student needs regarding learning deception detection*. Both were measured using 2 Likert-scale items (ranging from 1 – 7; “strongly disagree” to “strongly agree”). An example item from the game subscale includes “When I play a video game, I feel like I’m able to satisfy some of my own personal needs.” The reliability was acceptable for the needs in games scale ($\alpha = .89$, $M = 4.27$, $SD = 2.01$) and acceptable for the needs in deception scale ($\alpha = .72$, $M = 4.84$, $SD = 1.32$)

Student knowledge. A *student knowledge* measure was adapted to examine whether prior knowledge predicted learning and motivation. This scale was composed of two subscales: (1) *student knowledge about games* and (2) *student knowledge about deception detection*. Both were measured using 2 Likert-scale items (ranging from 1 – 7; “strongly disagree” to “strongly agree”). An example item from the game subscale includes “Based on my previous video game knowledge, I feel prepared to learn how to play a new video game.” The reliability was acceptable for the knowledge about games scale ($\alpha = .77$, $M = 4.05$, $SD = 1.94$); however, the reliability for the knowledge toward deception scale was unacceptable ($\alpha = .50$, $M = 4.10$, $SD = 1.52$). Because the interest in deception scale was unacceptable, further analysis examined the degree to which the two items in this subscale were correlated ($r = .34$, $p = .006$); the two items were significantly correlated.

Results

Statistical software SPSS version 24 was used to analyze data in this report. To examine the instrumentation designed to measure five SCFs, scores for Cronbach’s alphas, means, and standard deviations were calculated for each subscale. A summary of each score is outlined in the previous methods section to indicate which subscales resulted in an acceptable (greater than .70) level of internal consistency.

An examination of the amount of total time each participant spent in the survey was calculated to investigate the extent to which additional questions could be added to future iterations of the instrument. Of the 64 valid participants, 15 spent more time in the survey well outside the normal distribution (time spent in the survey was over 100 minutes); these cases were specifically removed from the time analysis to accurately assess time-taken to complete the survey. After removing outliers, the average time participants took to complete the pilot survey (n = 49) was 52.2 minutes (*Mdn* = 50 minutes).

Discussion

The goal of the pilot study was to test the suitability of a newly developed instrument designed to measure five SCFs in relation to learning in digital games and in relation to the topic of deception detection. As stated, this instrumentation was analyzed under three criteria (1) inter-item internal consistency; (2) variability between respondent answer choices; and (3) time-spent in the survey.

Regarding inter-item consistency, five subscales featured questions with an acceptable level of reliability (*interest in games; beliefs about games; needs in games; needs in deception; and knowledge about games*) and the three remaining subscales exhibited an unacceptable level of reliability (*interest in deception; beliefs about deception; and knowledge about deception*). The lower reliabilities are likely the result of two primary issues: first using only 2-items to form a subscale is not a particularly robust measure. Subscales composed of only two items may not be sufficiently assessed using Cronbach's alpha. As such, correlations were calculated to examine the relationship between the three subscales with unacceptable reliabilities. Two of these subscales were shown to be significantly correlated. However, the correlations were small to medium. Thus, each subscale with an unacceptable reliability required revision (see Table 3).

Second, there is likely an issue of content validity between the items used to form the subscales with low reliability. As a general observation, a pattern emerged in that the deception oriented questions were less reliable than the game oriented questions. For example, the subscale on *beliefs about deception* resulted in the lowest internal consistency between the following two questions: "I believe there is more information I could learn about the topic of deception detection" and "I believe I'm capable of learning to tell the difference between truths and lies." Although both items focus on student beliefs, it seems clear that they may not measure the same phenomenon; thus, they cannot be summed together into a composite measure. The first asks for reflection on whether information exists on a topic and the other asks whether a participant can learn it.

Regarding variability, the survey items captured a range of responses with a standard deviation of 1 for each subscale. Because this study examines the ways that different pre-existing factors may predict learning and motivation, this is useful because it shows that the items used in this measurement are not likely to produce homogenous responses. Therefore, the instrument should produce overall responses that sufficiently vary between individuals to allow for more power in the main experiment final analyses.

Lastly, it is also necessary to consider how long the study takes participants to complete. As mentioned previously, the measures tested in this dissertation represent just one small portion of a much larger study. It is predicted that the main experiment may take participants up to 2.5 hours to complete. Because participants may experience fatigue, it is important to consider the study length. The measures that were pilot tested took only 52 minutes for the average participant to complete (not including outliers). Thus, the subscales measuring student-centered factors could benefit from adding additional questions. Subscales with items that already have a high internal reliability may benefit from adding another question to enhance the robustness of the measure. The student-goals subscales were composed of just single-item measures; these measures may also benefit from adding additional questions to form a composite measure. Therefore, each of the subscales were revised for use in the main experiment (see Table 3).

Limitations

In this pilot test, the sample-size was relatively small ($N = 64$ valid cases). It is possible that with more participants, a greater level of power may contribute to having measures with more acceptable levels of reliability. For example, the subscale on *interest about deception* resulted in an alpha level of .69. Though this is technically under the level of .70 acceptability, perhaps with additional items and more participant responses, this subscale would have resulted in a more acceptable reliability.

Summary

In summary, Study I utilized a survey method to test the instrumentation designed to measure five student-centered factors. While five of the subscales contributed to an acceptable level of reliability, three subscales did not. Nonetheless, the subscales contributed toward participant responses that varied with a standard deviation above one. After assessing the amount of time participants spent in the survey, it was determined that more questions could be added to each subscale to enhance the robustness of the measures. As such, the items were revised in each of the subscales with low reliability to better improve content validity. In addition, more questions (formulated based on the previously presented literature on SCFs) were added to each subscale to create a more robust measure.

Table 3

SCF Measure Revisions

Subscale	Original	Revised
Interest in games	I'm interested in learning new information from playing a video game.	I'm interested in learning new information from playing a video game.
	I find the idea of learning from a video game to be intriguing.	I find the idea of learning from a video game to be intriguing.
		Because I'm interested in playing video games, I'm also interested in using video games as a learning tool
Interest in deception	I'm interested in learning more about the topic of deception detection.	I'm interested in learning more about the topic of deception detection.
	Learning deception detection skills is likely to be a valuable experience for me.	Learning deception detection is an intriguing subject area to me.
		Because I'm interested in the topic of deception detection, I'm also interested in learning more about this subject area.
Belief in games	I believe I can learn something useful from a video game.	I believe I can learn something useful from a video game.
	I think that I am capable of learning from a video game.	I think that I am capable of learning from a video game.
		I believe that I can learn real world knowledge and skills form playing video games.
Belief in deception	I believe there is more information I could learn about the topic of deception detection.	I believe there is more information I could learn about the topic of deception detection.
	I believe I'm capable of learning to tell the difference between truths and lies.	I believe I could learn how to better tell the difference between truths and lies.
		I believe that I can learn deception detection skills through training on the topic.
Approach goals	My goal when playing a video game is to perform well so others will know how capable I am.	My goal when playing a video game is to perform well so others will know how capable I am.
	My goal when learning a new topic is to show others how capable I am.	If I do well when playing a video game, I'm glad because others may find out.
		My goal when learning a new topic is to show others how capable I am.
		If I do well when learning about a topic like deception detection, I would be glad because others may find out.
Avoidance goals	My goal when playing a video game is to try not to perform badly.	My goal when playing a video game is to try not to perform badly.
	My goal when learning something new is to try not to perform badly.	My goal when learning something new is to try not to perform badly.
		If I do poorly when playing a video game, I'm worried because others may find out

		If I do poorly when learning about a topic like deception detection, I would be worried because others may find out.
Mastery goals	My goal when playing a video game is to perform well so I will know that I have mastered the game.	My goal when playing a video game is usually to perform well so I will know that I have mastered the game.
	My goal when learning new information is to master the topic so I know that I am skilled in the subject.	If I do well when playing a video game, I'm glad simply because I know I have performed well.
		My goal when learning new information is to master the topic so I know that I am skilled in the subject.
		If I do well when learning about a topic like deception detection, I would be glad simply because I know I have performed well.
Needs in games	When I play a video game, I feel like I'm able to satisfy some of my own personal needs.	When I play a video game, I feel like I'm able to satisfy some of my own personal needs.
	I find video games rewarding to play on a personal level.	I find video games rewarding to play on a personal level.
		I feel like my experience when playing video games is usually fulfilling.
Needs in deception	Learning about a topic like deception detection allows me to satisfy some of my own personal needs.	Learning about a topic like deception detection could allow me to satisfy a personal need.
	I find the idea of learning more about deception detection personally rewarding.	I think the process of learning more about deception detection would be personally rewarding.
		I think learning about deception detection could be a fulfilling experience.
Knowledge in games	Based on my previous video game knowledge, I feel prepared to learn how to play a new video game.	Based on my previous video game knowledge, I feel prepared to learn how to play a new video game.
	Because of my prior video game play experience, I understand how video games all basically work.	Because of my prior video game play experience, I generally understand how video games all basically work.
		If I were to start a new video game, I could probably figure out the controls quickly.
Knowledge in deception	Based on my previous knowledge about deception, I feel prepared to learn more about deception detection.	Based on my previous knowledge about deception, I feel prepared to learn more about deception detection.
	I already have a good foundation of knowledge on the topic of deception detection.	I know enough about the basics of detecting deception, so I could continue building on my foundation of knowledge in that area.
		If I were to start learning more about deception detection, I could probably pick it up quickly.

IV. Study II: Focus Groups and Interviews

Method

The goal of Study II was to explore the degree that the five pre-existing student-centered factors (SCFs; interest, beliefs, goals, needs, & knowledge) explain a person's experience when learning from a digital game. Qualitative methods were utilized to learn more about how participants engage in a new game-based learning platform in relation to their past experiences and expectations regarding video games. This study also provided an opportunity for participants to play an alpha version of VERITAS; this is a version of the game designed specifically for testing to help identify potential problems before the final version of the game is complete. To examine participant perspectives and experiences playing VERITAS, focus groups and interviews were conducted.

Study II and III of this dissertation use an *embedded* approach to mixed-methods research. In an embedded design, one data type supports and plays a secondary role to a primary data type and the two data sets are not weighed entirely equally; one type of data is collected first to examine a baseline level of understanding and this data is used to form initial impressions about a phenomenon. Both data types are considered in the final stage of interpretation (Creswell & Plano Clark, 2007; Myers, 2014). Following this approach, the qualitative data gathered from the focus groups and interviews in study II are used to inform an initial impression regarding how SCFs may impact user experiences in VERITAS. Following this stage, study III (Chapter V) is used to describe the primary data collection stage, which uses a pretest-posttest experimental design. Following both the qualitative and quantitative stages of data collection, insights from both studies are mixed to enhance the overall interpretation in the discussion.

Focus Group Participants

Volunteer participants (*N* = 63 valid cases) included college students enrolled at a large university located in the Western (*n* = 26) and Midwestern (*n* = 37) United States. Students received a nominal amount of course credit and a $20 gift card for participation. Participants included the following demographics: 57.1% females and 42.9% males with a mean age of 19.66 years (*SD* = 1.31). Participants represented a variety of student levels: 17.5% first-years, 44.4% second-years, 19% third-years, 12.7% fourth-years, and 6.3% fifth-years. Regarding ethnicity, 1.6% was Black or African American, 58.7% were Caucasian or white, 15.9% were East Asian, 11.1% were Latina/o, 4.8% were multiracial, 1.6% were Middle Eastern or Arabic, 4.8% were South Asian or Indian, and 1.6% reported ethnicity as "other" (1.6%). In addition, 84.1% reported that English was their first language and 15.9% reported that English was not their first language.

Focus Group Procedure

Participants volunteered for the focus group study online and completed the following procedures: first, a link to a 30-minute online pretest was emailed to participants with instructions to complete the pretest before arriving at the lab (pretest part I). Second, upon lab arrival, participants completed additional pretest materials (pretest part II). Third, participants played a DGBL deception detection training program called VERITAS (described next) for approximately 1 hour and then completed posttest measures. Lastly, students participated in focus groups to discuss their experiences playing the learning game. This chapter summarizes procedures as they occurred in the larger NSF funded research project; however, the primary focus here is to describe the methods, results, and discussion points that apply specifically to the dissertation hypotheses of interest from the focus group and interview data.

VERITAS training game. *Veracity Education and Reactance Instruction through Technology and Applied Skills* (VERITAS) is a game-based training program designed specifically to teach deception detection knowledge and skills. Mandatory play-time within VERITAS lasts approximately one hour. In VERITAS, players work through two scenarios; in each, users assess when an actor in a hypothetical story is lying or telling the truth. In scenario 1, players interview a job applicant to assess whether she is trustworthy; in scenario 2, players interrogate a suspect to evaluate whether she engaged in theft. Both scenario actors feature demographic qualities representative of college-aged, white, females to reduce confounding variables (see Figure 1 for in-game images).

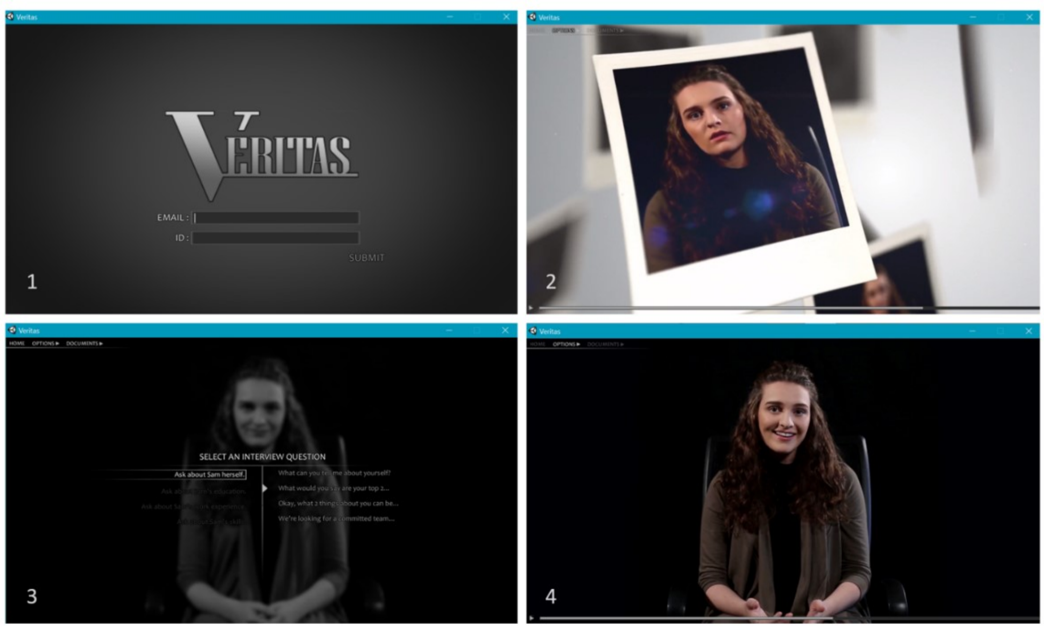

Figure 1. Four in-game images from VERITAS are shown. Quadrant 1 shows the title screen; quadrant 2 shows an in-game cutscene describing instructions; quadrant 3 shows a dialogue tree menu; quadrant 4 shows the actor speaking in hypothetical scenario 1.

In both scenarios, players select questions from an onscreen menu via a dialogue tree while pre-recorded actors respond with answers designed to display reliable cues of truth (including detail; spontaneous corrections; logical structure; certainty & embracement; smiling & relaxation; plausibility; and involvement) or deception (inconsistency with other statements; lack of smiling; more negative language; greater cognitive load; tension; implausibility; uncertainty; more repetitive language; and vagueness). These deception cues overall relate to three general patterns: signs of uncertainty, cognitive load, and tension. VERITAS also teaches participants to become aware of stereotypical cues that have been shown to be unreliable in deception detection (eye gaze; fidgeting; and nervousness) so that they can avoid using these unreliable cues (see Chapter I for a literature review on truth and deception detection cues). For each statement that the job applicant and the suspect, respectively, make in the game, players are required to assess: (1) whether the statement is truthful or deceptive; (2) the player's degree of confidence in this assessment (1 – 5; "not confident" to "very confident"); and (3) the cue the participant is relying on when making each credibility assessment out of a list of options (from the previously discussed cues for truth, deception, and stereotypes).

The game begins with a short introduction for each scenario that is outlined by a University professor. Next, participants play scenario 1 which affords subjects the opportunity to practice identifying truth and deception paired with immediate feedback in the context of a hypothetical interview. Following scenario 1, participants view a 5-minute deception detection training given by the same University professor. The training reviews myths, reliable truth cues, and deceptive cues. Videos, text, and images are featured in the training. After the training, participants proceed into the second scenario to experience further practice opportunities in identifying truths and deception paired with immediate feedback responses in the context of an office theft. In total, the game has 36 mandatory and 78 total interview questions (42 questions are optional) that participants can ask to practice their deception detection knowledge and skills.

Focus groups. Eight focus groups were conducted (n = 59 participants). Each focus group was led by the same primary facilitator and followed a semi-structured approach; a script and a list of questions were pre-generated, but the researcher probed to ask additional questions. The groups were composed of somewhat homogenous individuals containing college-aged students; however, the facilitator encouraged a variety of perspectives using a critical focus group style. Participants were free to disagree with one another and provide alternative perspectives regarding learning from games. Because student-centered factors presumably impact one's learning experience prior to and during gameplay, the moderator asked participants to think back to when they first began playing and asked them to recall whether each of the five student-centered factors impacted their experience playing VERITAS. As such, the moderator facilitated the flow of the interaction and asked additional probing questions.

Focus group script and questions. The focus group script and associated questions were adapted from materials created by Dr. Debra Lieberman from the University of California, Santa Barbara. These materials were previously used in focus groups examining user experiences with "power bands" that were designed to monitor children's physical activity through a tablet application. The script began with introducing participants to the researcher and explaining the purpose of the focus group. Next, the moderator addressed each participant by name (with associated nametags) and explained instructions for how to participate. Participants were encouraged to contribute their honest opinion regardless of whether they offered criticism or praise.

To contribute to the discussion, participants were encouraged to either speak up or raise their hand. They were also reassured that they would not be identified by name in reporting results. Questions were grouped ahead of time and then asked to participants according to the following categories: (1) general evaluation; (2) interests; (3) beliefs; (4) goals; (5) needs; (6) prior knowledge; and (7) and additional questions (see Appendix C for full focus group script & questions). Depending on the flow and timing of each session, the moderator encouraged every single participant to voice their perspective at least once per categorical topic. Each focus group was video recorded with the verbal content later transcribed by an undergraduate research assistant.

Interview Participants

In addition to focus groups with student participants, law enforcement officers (n = 3) employed in the region of a large western university were also recruited to explore their experiences playing VERITAS. Officers were also offered a $20 gift card for participation; however, two of the officers declined to accept this incentive. Their demographics included 3 males, all of Caucasian or white ethnicity, and they had worked as an officer for 16, 18, and 23 years, respectively, in law enforcement. In accordance with the goals of the larger NSF funded research project, VERITAS was designed to train police officers in research-based deception detection skills. As such, it was necessary to provide an opportunity for officers to alpha-test the game. Because police officers represent a demographic containing a more specialized expertise compared to college students, exemplar quotes from their interviews are compared to exemplar quotes from focus groups. Although the sample size of officers who participated in the interviews was small, it served as a starting point for examining officer perspectives in play-testing VERITAS.

Interview Procedure

Police officers volunteered to participate via email and then arrived at the lab for a scheduled appointment. Upon arriving in the lab, officers played VERITAS for approximately 1 hour and then participated in an interview lasting approximately 20 minutes. Each interview was led by the same primary facilitator who led the focus groups and followed a semi-structured approach; a list of questions was pre-generated using the same categories as above and in the same sequence; however, the researcher probed to ask additional questions. Because SCFs may presumably impact one's learning experience prior to and during gameplay, the interviewer asked participants to think back to when they first began playing to recall whether each of the five SCFs impacted the officer's experience playing VERITAS.

Interview questions. The interview format followed a similar protocol as used in the focus groups and contained identical questions. Interviewees were encouraged to contribute their honest opinion regardless of whether they offered criticism or praise. Officers were reassured that they would not be identified by name in reporting results. Questions were categorized by the following topics: (1) general evaluation; (2) interests; (3) beliefs; (4) goals; (5) needs; (6) prior knowledge; and (7) additional questions (see Appendix C for a full list of questions). Each interview was video recorded with the verbal content later transcribed by an undergraduate research assistant.

Thematic Coding Analysis Procedure

Analysis of the focus group and interview qualitative data followed Boyatzis' (1998) procedures for thematic analysis and code development. According to Boyatzis, a thematic analysis is a process in which qualitative content is coded and categorized into a list of emergent themes; themes represent a pattern of data that can be used to describe, organize, and interpret observable phenomena at both a manifest level (directly observable) and latent (underlying observations). The purpose of performing a thematic analysis is to (1) develop a way of seeing and understanding data; (2) make sense of unrelated material; (3) analyze qualitative information; (4) systematically observe phenomena; and (5) turn qualitative experiences into quantitative information (Boyatzis, 1998).

Coding of themes was completed using NVivo, a qualitative data analysis and coding software tool. The unit of analysis at which coding took place was at the topic level for each individual speaker: lines of related verbal content were labeled as one coded instance starting when a speaker began talking about a salient topic and ending when they made their point clear or another participant began to voice their own perspective. To identify codes and themes, analysis was guided by Boyatzis' (1998) three-step approach to developing theory-driven codes. A researcher following theory-driven code development begins with a theory, derives codes using the theory as a lens, and then examines indicators that emerge within their data in relation to the theories of interest. Given the literature reviewed in this dissertation, this analysis was designed to explore the impact of five SCFs starting from the pre-established theoretical positions outlined in Chapter II.

In stage one of Boyatzis theory-driven approach to code development, it is recommended that a researcher first consider sampling and design issues. Regarding sampling, a student sample was recruited for this study. Because this research explores game-based learning, a student sample represents an ideal consulting group as college students have already spent much of their time in learning environments; thus, they can assess the contexts in which a learning program might be effective. Because this study also explores the specific topic of learning deception detection, a police officer subsample also represents an ideal group to consult as officers spend much of their time assessing credibility. Regarding the study design, Morgan and Krueger (1993) explain that focus groups are useful when investigating complex behaviors and motivations. Therefore, focus groups (and interviews similarly) were selected to explore one's perceptions and experiences when it comes to examining SCFs and their potential to explain DGBL.

In stage two of Boyatzis theory-driven approach to code development, a process of creating codes is outlined: first, codes are generated based on relevant existing theories; second, codes are reviewed and re-written as appropriate; third the reliability of codes is considered. In line with this procedure, existing categories were first created based on the theories discussed previously in the areas of student interests, beliefs, goals, needs, and prior knowledge. Next, coding within these categories was performed in collaboration with Braun and Clark's (2006) open coding procedures. Braun and Clark recommend that a researcher should code themes as they emerge through an iterative process of reviewing and reflecting on the previously coded material. Thus, codes within each category area emerged through open coding to thematically describe participant experiences as they were discussed.

After coding verbal statements within the theory based and newly emergent codes, codes were reviewed and re-written as appropriate. This process was guided by Bakeman and Gottmann's (1997) considerations for coding scheme development which outlines a process of *splitting* and *lumping* codes to better organize themes according to their shared features and separating codes as needed. Thus, codes were combined into similar categories and divided appropriately to best categorize similar topics into themes until saturation of represented topics was achieved for the theories of interest. Final codes were documented in a codebook (Appendix D) following Boyatzis recommendations for what to include when creating a code: (1) labels; (2) definitions; (3) descriptions of indicators; (4) descriptions of exclusions; and (5) exemplars.

Throughout this iterative process of coding, determining and maintaining the reliability of each code was considered and revisited. Boyatzis explains that reliability refers to the consistency of observations, labeling, and interpretation. It is not enough to simply observe patterns, one must do so in a reliable manner. To maintain reliability, effort was made to categorize themes under existing codes when appropriate rather than creating unnecessary emergent codes. Codes were also reviewed as a group to examine the degree that statements were similar in comparison to each individual coded statement when organized as a theme.

In stage three of Boyatzis' theory-driven approach to code development, it is recommended that a researcher applies codes to the data, determines validity, and interprets results. Whereas the purpose of stage one and two is to create and adapt codes based on existing theories, the third stage is designed to revisit theories and examine how results fit within the context of past research. Thus, interpretation from this stage is elaborated upon in the following results and discussion section to explore insights revealed regarding the potential impact of five SCFs on experiences in learning and motivation in DGBL.

Results and Discussion

Data from focus groups and interviews were coded following the previously discussed coding scheme (see Appendix D) developed to explore the impact of SCFs on user experiences playing a deception detection digital training game. Emergent themes that arose from discussion questions were organized by theoretical topic and ascribed to SCF categories as appropriate; emergent themes outlined the types of responses participants asserted in explaining their perceptions related to how SCFs impacted in-game experiences playing VERITAS.

In the following report, exemplary quotes highlight each theme with selections representing both the student and police officer samples to compare perceptions (when available). In each section, first a review of the themes according to student perceptions is discussed. This is followed by a description of the police officer perspectives with regards to the same theme. Fifteen emergent themes were organized within the following codes: For interests, themes were: (1) absent game mechanics and (2) helpful game mechanics. For beliefs, themes were: (3) games help learning and (4) games do not help learning. For goals, themes were: (5) competition; (6) topic learning; (7) narrative enjoyment; and (8) hurried finish. For needs, themes were: (9) entertainment seeking; (10) escapism; (11) socializing; and (12) entertainment lacking. For knowledge, themes were: (13) intuitive design; (14) hypothetical challenges; and (15) overconfidence.

Themes for Interests

As discussed previously, research suggests that when students are interested in a topic, they may be more motivated to learn (Hidi, 2001; Pintrich, 2003). This poses positive implications for digital game-based learning because if researchers assume that games are enjoyable and motivating for all learners, a student's interest in digital games should positively impact their experience playing a digital game and this may help learning. However, negative implications may also exist; if a student is not interested in video games, they might not find the experience of learning from a digital game to be productive and this may impact their learning negatively. To explore this phenomenon, the following two questions were posed: "How often do you play video games?" and "How did your interest in playing video games impact your experience playing VERITAS?" Responses were coded into the following two emergent categories: (1) absent game mechanics and (2) helpful game mechanics.

Absent game mechanics. Students were asked to describe how often they played video games and how their interest in games impacted their experience in VERITAS to examine the extent to which their interest influenced their learning. However, the question about student interests may have been too abstract to effectively assess participant perceptions in this area. Instead of providing a direct answer to this question, participants largely avoided addressing the question and instead explained that they could not make this assessment because they did not view VERITAS as a video game (42 comments). Instead, they reported that it functioned more like a simple training simulator and it did not fit their definition of a video game. Therefore, their interest in video games seemed irrelevant in this context; they could not explain how their level of interest in video games (either low or high) impacted their experience playing VERITAS since it did not qualify as a video game. The following exemplary comments from students highlight this theme:

> *When I was playing VERITAS, I didn't think it was a real video game, just because my definition for video games is kinda targeted, like Counterstrike, or Overwatch.*

> *I kind of think of video games as like, you know, Mario Kart or something, so to me that was more like watching TV, or like, maybe like a video you would see in class. So, I don't think it really affected the way I did it.*

> *I also did not think of it as a game just because when I think game, I think like, not a real-life scenario… So, I didn't really think about my experiences in video games at all because I didn't really make the connection.*

Similarly, all three police officers discussed this theme as well. The following exemplary comments from officers highlight this theme:

> *I think that, since I hold the belief of what I think gaming is, then by contrast I was viewing it not as much of a game. And so, it's not… you know… you're not enticed the same way, you're not stimulated the same way.*

> *Well I wouldn't necessarily equate VERITAS with a video game, and I've had some exposure to similar training, I guess, environments. As law enforcement in California, there's a number of training programs or features that are exactly like this, where it's basically a video, not necessarily a video game, but a video and then you have to answer questions and go through scenarios, so it's actually quite similar.*

> *When I came in, I did hear you guys keep calling it a video game… and I guess yeah it is, but that's not how I thought of it as, I just, it was a learning tool for me.*

Helpful game mechanics. Even though most participants agreed that VERITAS did not fit their conventional definition of a video game, participants paradoxically appreciated the game-like mechanics featured in the training and recognized that these mechanics may have aided in learning processes (24 comments). The associated game-like features enhanced their learning to some degree; comments acknowledged that the format in which the training was offered was closer to being like a game in comparison to more traditional lecture training. They discussed how the training game helped them to focus for an extended time when a textbook would not have engaged them in the same way. Likewise, the game prompted participants to test themselves and see how well they could perform in learning the topic. The following exemplary comments from students highlight this theme:

> *As someone who has grown up with videogames and brought my entire desktop with me to college, I can definitely see the game mechanics being used and that did help me with the system a bit.*

> *That made me think of like my childhood playing a lot of games like jump-start kindergarten, and those series of games and I thought, oh, those are kinda connecting with the theme about learning, and I was motivated to learn, oh this is a college advised computer game.*

> *When you play a video game you are trying to win, and when I saw that you were kinda getting how much you were getting right out of wrong, or wrong, it kinda did trigger a little bit of try to win or whatever, try to get all of it correct.*

Echoing this theme, the officers agreed that VERITAS' game-like features enhanced their learning; specifically, they discussed benefits from features such as the game's scenarios, opportunities for practice that were not afforded in their daily work, and the benefit of instant feedback. The following exemplary comments from officers highlight this theme:

> *Well, I really enjoyed the scenarios themselves, I thought they were very well developed…For me, I don't get to interview a lot of criminals much anymore at this point in my career, so I felt myself really, really rusty, so the tutorial was a big reminder, and a key help for me moving forward through the, into the second scenario.*

Yeah, so I believe skill acquisition requires repetition, of which if this game is a tool to acquire skill, uh, there was enough repetition there where you started to pick up on things.

I liked the responses, after a certain question came up, then you would, they would ask you if they were being truthful or deceptive, and then the degrees of how certain you were, and then they would give you a couple questions like, well, why did you come up with that conclusion.... I liked the response right away.

Summary on interests. Overall responses from participants indicate that their existing schemata for defining what qualifies as a video game may not be activated within the context of a learning game such as VERITAS. In other words, participants may not view a training simulator with game-like features as a game. Based on these insights, it can be presumed that a student's level of interest in video games will likely not play any conscious role in influencing a student's experience in the training game itself if a game-based training does not appear as a game. Nonetheless, insights also suggest that a training using features of gameplay may still benefit learners. These results suggest positive implications for game-based learning: a training game designed specifically for teaching purposes should be equally effective and participants should find the game-like features motivating regardless of pre-existing interest in video games. Thus, based on responses from the focus groups and interviews, the impact of student interest should be relatively minor in the context of learning from a digital game-based learning program such as VERITAS.

Themes for Beliefs

Research also suggests that beliefs about one's capabilities and performance may impact their subsequent behavior and ability to achieve (Schunk, 1989; Schunk & Pajares, 2009). This poses some positive implications for game-based learning: if a student has a strong sense of efficacy in digital game play, this may translate to their ability to perform well in a training game. However, the opposite could occur in that if a student does not believe they are skilled in playing video games, this low level of confidence may negatively impact their ability to achieve in a learning game. To explore this phenomenon, the following two questions were posed: “What beliefs do you have about learning from video games?” and “What impact did your beliefs about learning from games have on your experience of playing VERITAS?” Responses were coded into the following two emergent categories: (3) games help learning and (4) games do not help learning.

Games help learning. Just as participants indicated that game-mechanics could be helpful in enhancing learning, most participants believed that digital games could be used for overt and unintended learning experiences (47 comments). They described instances in their own lives that they played digital games designed specifically for learning and other instances in which they learned skills in areas such as typing or math by playing entertainment games. Most students articulated the potential that video games could teach in some way. The following exemplary comments from students highlight this theme:

> *Well I think those games meant for you to learn more stuff, like those cool math games you played when you were little, I think those were pretty fun. They made learning pretty fun. So I kept on doing them and it obviously helped me because it applied concepts I needed to learn, but in a more fun and direct way*
>
> *Umm, I feel like certain features of videogames can be, because of how I envision games to be, serving as a motivating factor for you to do well, so in terms of learning, so when you learn it’s the full cognitive process and the purpose of that is just to make sure the conscious, and I feel that the aspect of a game, motivates you, and in that way, it could be effective.*
>
> *I think videogaming does actually teach you a lot. And there’s research for that as well, that it will help you learn how to read topographical maps, help you make decisions better and more rapidly, respond to new stimuli, and master new controls.*

Similarly, the police officers generally agreed that video games could be used as learning tools. They discussed the benefits of games and demonstrated a belief that games could teach in different ways. Although, one of the officer’s responses (third comment) seemed mixed. This officer indicated that games were primarily used for entertainment, but they could still teach. The following exemplary comments from officers highlight this theme:

> *Um, well I think, I think there's definitely things that you can learn from video games, certainly it allows you to obviously make mistakes and not in a real-world situation where the consequences can be extremely high, and so I absolutely believe that.*

> *So, I am a visual learner, my son is a visual learner, and I feel that gaming allows for a lot of visual learning plus repetition.*

> *I equate video games more of just entertainment, and sorcery, and driving, and things like that. This was educational, and in our line of work, sometimes we do have webinars and things like that, we have to watch videos for our work, and um, they're helpful for our everyday job. So, I felt something like this was the same thing. It's helpful, it kind of teaches you, some of those preconceptions you do have, those don't always work, and so it was just a good learning tool.*

Games do not help learning. Although most participants could articulate the ways a video game could work as a learning tool, not all participants shared this belief. A subset perceived video games simply as leisure or entertainment activities that offered no clear learning benefits (22 comments). They explained that entertainment video games such as *Mario Kart* or *Call of Duty* only taught players to play the game, but did not teach any useful skills or knowledge that could be translated to real life uses. Students who asserted this belief also explained that even video games-designed specifically for learning were not effective tools in comparison to traditional methods. The following exemplary comments from students highlight this theme:

> *Ok well when I was little my parents made me play those educational games so I can say that I hated them…so I just stopped using them, so they were less effective.*

> *I also feel like videogames make it too concentrated on the videogames that you don't always know how to apply it in your life…with the VERITAS game, I could just be playing that and pick up on all these things, but then like I could just forget it later and never think about that in a real-life situation.*

> *I just feel like I don't really play video games, so I don't really have an opinion…in*

> *the realm of like learning something, I think it is very limited like compared to other things in this world.*

On this topic, though the officers genuinely indicated that they believed video games could be used as teaching tools, the officer who exhibited a mixed response previously seemed to align more with the position that video games were not completely effective in teaching purposes and they were more suited toward functioning as entertainment tools. The following exemplary comment from an officer highlights this theme:

> *I'm not sure. I don't really have a good right or wrong answer. If I was to say for me, I don't think so, but uh, again, I grew up in an age where video games were purely for entertainment, and I know they've advanced quite a bit, but that's kind of how I think of them.*

Summary on beliefs. Although many participants believed that video games could teach skills, knowledge, and abilities, others believed that video games were not effective educational tools. Participants indicated that student learning from games was largely driven by the specific type of game. They acknowledged that even though entertainment games could teach, games developed specifically for learning purposes were more likely to accomplish this goal. Others took the position that games simply were not as useful as more conventional trainings; thus, they did not believe that information learned in video games, regardless of type, contributed to real-life benefits. These beliefs pose interesting implications for DGBL. It is likely that a student who believes video games can be used as an effective teaching tool may be able to learn more form a game-based training program; whereas a participant who does not believe any type of video game is an effective teaching tool is not likely to perform as well or find DGBL to be motivating. Therefore, based on responses from the focus groups and interviews, the impact of student beliefs may play a larger role in the context of learning from a DGBL program such as VERITAS.

Themes for Goals

Studies show that learning goals may impact one's motivation and behavior in learning situations (Erhel & Jamet, 2013). Presumably, students driven by the goal of achieving mastery in a topic and students driven by the goal of impressing others (an approach-orientation) may both do well in DGBL. However, students who seek to avoid showing others that they may perform badly will likely not perform well in a game-based training due to the potential for social comparison with more capable peers. To explore this phenomenon, the following two questions were posed: "When you were playing the game, what were your primary goals?" and "How do you think your goals impacted your experience of playing Veritas?" Responses were coded into the following four emergent categories: (5) competition; (6) topic learning; (7) narrative enjoyment; and (8) hurried finish.

Competition. In describing what goals players typically follow when playing a video game in comparison to what goals guided their play in VERITAS, many participants discussed a goal orientation that fit a competitive profile (40 comments). Some reported their competitiveness from an interpersonal perspective in which they hoped to do better than their peers; others assumed a level of intrapersonal competitiveness in which they were driven to simply perform better than themselves or to beat the system. This intrapersonal competitiveness seems appropriate because VERITAS functions as a single-player game. In this vein, participants discussed how they simple wanted to be correct in their assessments. This did not mean they wanted to necessarily learn the topic, but they wanted to be perceived as doing well within the context of the game. This fits within the style of an *approach* type of goal orientation. Underlying students' comments was a need to answer questions correctly to appear competent. The following exemplary comments from students highlight this theme:

> *Yeah like every time I would answer the question I would always want to get it right and sometimes it didn't happen, so I was like "grrr" and I had that emotional response.*
>
> *I think that mostly its competitiveness, like, I think, at the end it's about the end results. It's about beating your score, about being the top, about being the first person, to win first place.*
>
> *For me, play to win, so like I would get a little bit frustrated if I got it wrong, just because to me, I knew this was a research study, that my scores, even though my name wasn't attached to it, my scores would go in somewhere and so like, I am that competitive.*

Similarly, all three police officers displayed a strong approach goal orientation toward interpersonal competitiveness. One of the officers indicated that he wanted to achieve more than the average college student should be able to. Two of the other police officers had known each other previously and played the game during the same session; both discussed how their primary goal was to perform better than the other. This level of competitiveness was tied to their identity. An underlying idea was present in their comments in that the officers wanted to do well to receive vindication showing that they were good at their jobs. The following exemplary comments from officers highlight this theme:

> *Okay, so as I was playing, I wanted to win, and by win I meant do well. And by do well I meant - this was a game framed toward me, or toward law enforcement, and I thought, 'Well 16 years as a cop, I should do well.' Or I think of myself as a good cop so therefore I should do better in this kind of thing. And/or this is potentially something that I do every day where we try to determine conscientiousness of guilt, deception, and so I want to say, well I should do better than the college student that doesn't do the same thing as frequently as I do.*
>
> *Well, he and I made like a pact before, who's gonna do better? We're competitive by nature, so yeah, that was the first thing when we walked in the door, I was like, does this thing give you a score, can we compete? So yeah, your colleague was quick to say, well you know, you can, and we were like, that's it, alright. [laughs] But also, you know, there's always a little bit of pride in that, that we wanna be able to say*

we're fairly good at our jobs, and we figured this is part of our jobs, so we wanna make sure we're being as efficient as we can.

Oh, I'm very competitive. So um, but I think it's both, I think it's both, you know you pride yourself. Especially with the position I am, and in investigations, there's a lot of follow up interviewing to do with witnesses and victims and then suspects. So you wanna be good at your job. So this, professionally, you wanna do well, because you know, all those classes, how to interview people, and things like that, you want to put it into play in a game like this. So, I wanted to do well for myself, but I also wanted to do well like after the [other officer] gets done, I wanna compare like, so how'd you do? Because I wanna see if I did better than you.

Topic learning. Participants also discussed that one of their goals was to genuinely learn the content material that VERITAS was designed to teach: deception detection (27 comments). Participants who displayed this goal described the interesting nature of learning about deception and the potential real-life rewards they could experience if they mastered the topic. The underlying motivation for mastering the material varied as some students asserted that they wanted to learn how to better identify deception, but a small handful showed interest in learning the content to become better deceivers. Still, the uniting theme of this code demonstrated the goal of working to learn the information at hand. This goal style fits within the context of a *mastery* orientation in which a subject is genuinely trying to learn more about a topic. The following exemplary comments from students highlight this theme:

I think my goal was just to learn about deception because it is a useful thing to know about and I think it just made me pay more attention. When they gave us feedback, it made me pay more attention to the feedback, because I wanted to know 'OK this is something to look out for.'

Yeah, I definitely came into it wanting to learn about deception, just cause I didn't really know where my skills lied, like at first I thought I was really good, but then I found out I had been lied to a lot.

I wanted to learn to detect deception, and to also learn how to detect a lie, and lie better. I just feel like you have a long life and a lot of people are going to lie and it's a skill I really wanted to learn…just because I think it's going to be highly applicable throughout the rest of my life.

Similarly, the three police officers were also driven by a goal to learn the subject matter at hand as they found it especially relevant to their daily jobs. Just as with their competitive goals, the officer responses indicated interest in the topic because it represented a component tied to their identity as officers. They wanted to learn the material because officers should know the material. Their comments about the deception topic represented a need to show that they were already competent to some degree within the topic of deception detection:

> *I draw this distinction like well, I do this stuff all the time in the field out at work, and here we're in a sterile environment studying this concept.....I'm just, 'I hear what you're saying but real world, you're doing something like this.' And so there's a part of me that almost wanted to show that I had a skill set. Right? Does that make sense?*
>
> *But also, you know, there's always a little bit of pride in that, that we wanna be able to say we're fairly good at our jobs, and we figured this is part of our jobs, so we wanna make sure we're being as efficient as we can.*
>
> *I don't know if I had a goal in mind, I just wanted to see if, you know, I could pick up on those cues I felt were deceptive, and the video seemed to tell me I was very good at picking up on deception, but ok to a little above average on picking up truthfulness, so seems there's stuff I have to work on. So, but uh, I don't know if I had a goal, I just wanted to do well.*

Narrative enjoyment. An additional goal that emerged showed that some participants were driven to simply enjoy the narrative experience of VERITAS (9 comments). In VERITAS, two hypothetical story scenarios are used that feature narrative development within the context of an interview and a phone-theft (as explained previously). In this vein, participants were interested in the story itself: they wanted to know what happened and if their own predictions about the story were correct. The simple act of enjoying the story-based scenario and being able to participate in the story by making credibility assessments gave users a meaningful goal to achieve during game-play. The following exemplary comments from students highlight this theme:

> *I really wanted to find out the person who, well Carrie, well what did she do?*

My goal was to find the liar and, once I spotted the first one, I wanted to fire her. And once I caught on that she was a liar, I was like 'I'm going to fire you at the end, I don't care how many truths you give.

I wanted to, like I wanted to really figure out who was the villain in the end. It kinda got me through the end. I was trying to figure out if she was a good employee or not.

Hurried finish. Unfortunately, some participants explained that their only goal while playing VERITAS was to literally finish as soon as possible (11 comments). None of the police officers displayed this goal, but because students were completing the training (and participating in the focus group) to receive course credit, some simply wanted to complete the task and get their credit. Students who described this goal were not interested in doing well, learning the topic, or following the story. They simply wanted to be done. Their responses during the focus group were also terse; perhaps showing that they wanted to finish with the focus group as quickly as possible too. Interestingly, one of the comments (as shown below) suggested that there may have been a "killing" element to the storyline of VERITAS; however, no part of the storyline or plot suggests that anyone was killed. This type of comment shows how a participant who is only interested in finishing is unlikely to be paying adequate attention to the training at hand. The following exemplary comments from students highlight this theme:

I think I found that my goals were more along the lines of getting through it.

Umm, I think mine was just trying to get through it. I wasn't really trying to figure out who killed them, it wasn't, it didn't motivate me enough.

And you know how there's additional questions I just skipped all of those because I just wanted to get over the game.

Summary on goals. The literature reviewed previously discussed the ways in which student goals oriented toward mastery, approach, and avoidance can impact their subsequent learning. Insights from participants indicated similar goals: those who had competition goals demonstrated an *approach* orientation; those who had a topic learning goal demonstrated a *mastery* orientation. Participants following these two goal orientations found the game-based training motivating. However, some individuals were not interested in competing, learning the topic, or following the narrative; these students simply had a goal of finishing. Perhaps in the same vein, a goal to hurry and finish may map onto an *avoidance* orientation. This suggests that a game-based environment may not be motivating for all types of users and some may seek to disengage from the process and complete the program without putting in any focus or effort into the experience. Thus, based on responses from the focus groups and interviews, the impact of student goals may play a large role in the context of learning from a digital game-based learning program such as VERITAS.

Themes for Needs

Video game research explains that games have the potential to satisfy important human psychological needs such as competence, autonomy, and relatedness (Ryan and Deci, 2000). This has positive implications for DGBL because if a training can help satisfy a person's needs, they may be more motivated to participate and may subsequently learn more. However, if a person does not typically use video games to satisfy their human needs, they may not be motivated to play a game-based training. To explore this phenomenon, the following two questions were posed: "What are the primary reasons you play video games?" and "How did your reasons for playing video games impact your experience playing Veritas?"

It is worth noting that this question may have resulted in the concept of *needs* becoming conflated with the previous topic of *goals*. Although it was designed to explore "reasons for playing" as needs that are satisfied during game play, the focus group facilitator did not explicitly define the difference between needs and goals and opted to allow participants to respond as they saw fit. In addition, because this question was asked toward the end of each session, participant fatigue was becoming apparent; overall responses became terser and overlapped with responses from the goals topic. Still, relevant themes emerged and responses to these discussion questions were coded into the following four emergent categories: (9) entertainment seeking; (10) escapism; (11) socializing; and (12) entertainment lacking.

Entertainment seeking. Participants explained how playing video games helped them to satisfy needs related to seeking entertainment (20 comments). Comments described video games as tools that enhanced excitement, fun, engagement, and had an addictive quality. Though some explained that video games could be used to simply relieve boredom, the underlying idea was that it stimulated mental activity; thus, needs in this area satisfied a more active type of entertainment seeking. The following exemplary comments from students highlight this theme:

> *Sometimes I want something more engaging. It's actually kinda hard for me to just sit down and watch a movie, you know, because it's kinda boring and it's not very engaging.*
>
> *But for me the main thing is boredom. So basically whenever I am not in school, I am on phone apps like constantly. And every summer, there's always like one or two games that I'm super addicted to.*
>
> *It's fun, it passes time, it just depends on the game, basically, and the purpose.*

Two of the police officers also agreed that when playing a video game, it had the impact of satisfying entertainment needs. The following exemplary comments from officers highlight this theme:

> *Um, well, fun, it certainly had a level of excitement. These were, these tended to be like the first first-person shooter games that came on to the market, and even before that, when I was a child, I mean we're going back to the early days of video games,*

> *Pac Man and Donkey Kong. So certainly, as a kid, it was just a level of technology that we hadn't been exposed to before, so it was very neat.*

> *Yeah, I think it was purely entertainment. You have friends that also, friends growing up that are also playing video games...you know, I'm in my mid 40s', so when I was growing up as a kid, 10 years old, Pac Man and all those games were just coming out, and I was like wow, it was like when you buy, you know a CD or you get someone's new album that just dropped or something like that, you know.*

Escapism. Participants also indicated that when playing video games, it satisfied a need to escape the stress of normal life to acquire a more passive type of relaxation (13 comments). Comments in this area referred to games that could be used to relieve stress, unwind, or disconnect from the real world in some way. Although these comments were often related to passing time as well, it differed from active entertainment seeking because this theme referred to a need for inactivity. The following exemplary comments from students highlight this theme:

> *Just to destress, that kind of thing. Like when I'm at school, usually I only play videogames when I'm at home, so it's just to relax a little bit.*

> *Just kind of taking the mind off of it. Taking your mind off of everything that's going on.*

> *I just try to have fun, and I try to win, but I feel like I focus more on the relaxation part.*

In this vein, two of the police officers described the ways in which video games allowed them to escape from their normal lives and to reduce stress. The following exemplary comments from officers highlight this theme:

> *Um and you know, it's a little bit of an escape too, because you're in a different world, you're in a different place, you're interacting in a different way, so certainly that's another piece to it.*

> *So, a lot of times, video games for me are distraction tools for disconnect from your current reality and/or to create an alternate reality. And so, sometimes stress relief, disconnection...For me a lot of times I see gaming as a disconnect from reality.*

Socializing. Participants also discussed the ways that video games allowed them to satisfy social needs (15 comments). This theme maps on to Ryan and Deci's (2000) description of the need for relatedness, which games have been shown to satisfy. In this vein, participants discussed using video games as a vehicle to connect or bond with others. In contrast to students with more competitive goals, these participants did not play to beat their peers, rather they wanted to hang out in a digital world and complete in-game tasks with others. Interestingly, none of the officers reported satisfying strictly social needs through video games. The following exemplary comments from students highlight this theme:

> *I use it to stay in touch with my friends…because it's challenging and its fun and it's immersive - it gives us something to do and it allows us to have fun and kinda facilitates that.*

> *I really just play so I have something to relate to, like he plays a lot of video games, we're dating by the way. He plays a lot of video games, so I wanted to be able to kind of share that role with him. For me, it's more like the social bond with people who do play Pokémon Go, you know?*

> *I like to be social but, the reason I play most of the time is 'cause my friends from back home say "hey, want to play this game?" and we all decide to play and we just sit and play the game while we talk on Skype, just about random crap.*

Entertainment lacking. Thus far, these themes have depicted the type of needs students are normally able to satisfy through video games. In this fourth theme, participants discussed the ways that VERITAS specifically lacked entertainment qualities; therefore, it did not allow them to meet their needs in this area (7 comments). Though a relatively small number of participants discussed the fact that VERITAS did not allow them to meet needs related to entertainment, others throughout the focus group session generally indicated that the game play itself was not a "fun" activity. Because participants did not feel as if their entertainment needs were satisfied through VERITAS, this could have negatively impacted their experience in playing the game. The following exemplary comments from students highlight this theme:

> *So, since I like play videogames for fun, it was like more boring for me, just the game, so I didn't think it was like that great. Because my model or like my conception of a videogame is like something you do for fun.*

> *Yeah, I said I would play a game to enjoy it, but I don't know if I would say that VERITAS was enjoyable. Because it wasn't like something fun.*

> *Yes, like when I start I'm like OK I want to do this because I want to have fun. And once I started doing things, it's like OK I want to be good at this. But it wasn't that fun. Like compared to other videogames, so that kind of just like maybe seemed a bit repetitive, so that's what I got.*

Summary on needs. Participants indicated that when they play video games, they are able to satisfy some important needs such as a need to be entertained actively, to escape more passively, and to socialize with others. On one hand, this has positive implications for DGBL if a game can effectively tap into these qualities. However, participants indicate that VERTIAS may miss the mark when it comes to working as a tool that can effectively meet participant needs. Instead, VERITAS may be lacking as an entertaining game. As a result, if students are not able to meet their needs when playing VERITAS, they may not find the training motivating. Therefore, based on responses from the focus groups and interviews, the impact of student needs may play a large role in impacting participant learning negatively in the context of a DGBL program such as VERITAS.

Themes for Knowledge

Research in this last area shows that one's ability to learn new knowledge is dependent on one's pre-existing knowledge on a topic (Mayer, 2009; Sweller, Ayres, & Kalyuga, 2011). Learners with a solid foundation in an area are more likely to build upon it. This has positive implications for DGBL; if a user is already experienced in playing video games, they may be comfortable adapting to DGBL. Inversely, a person who has played few video games may be uncomfortable in DGBL. To explore this phenomenon, the following two questions were posed: "When you first started, did you think you could figure out how to play the game?" and "What impact did your prior knowledge about deception have on your experience of playing Veritas?" Responses to these discussion questions were coded into these last 3 emergent categories: (13) intuitive design; (14) hypothetical challenges; and (15) overconfidence.

Intuitive design. Participants largely indicated that VERITAS was easy to play and the design of the program was intuitive (35 comments). This insight is not surprising as the gameplay itself is based on dialogue-tree interactions and represents a simple version of a game-based training program. As such, participants said that anybody would have been able to play VERITAS; they did not need any prior video game experience to understand how to play. The following exemplary comments from students highlight this theme:

> *I feel like you don't have to be experienced with games to be honest. It's kind of logical. Like click, click, next. That's about it.*
>
> *Umm it seemed pretty straightforward to me so I wasn't worried about getting confused or lost or anything, I thought it was pretty clean.*
>
> *Yeah, I agree that it was like straightforward and they explained what you were going to do before you actually did it.*

Two of the officers also agreed that the game was simple and easy to play. The following exemplary comments from officers highlight this theme:

> *Yeah, you just follow the prompts, all clear.*
>
> *Because I think anyone who didn't play video games could go sit down, put on those headphones. As long as they knew how to use the mouse, I think they could go and follow along what the game was trying to provide and teach you.*

Hypothetical challenges. Although most participants indicated that VERITAS was easy to learn how to play, a few comments indicated that there could be an individual who may struggle to play the game; and that this may be a detriment to learning (6 comments). For example, those who struggle with technology may not adapt well to a game-based learning environment. The following exemplary comments from students highlight this theme:

> *Ummm, but for me it was really easy because it was a very basic layout, I think anyone that could work an iPhone effectively or check an email should be able to do that, although actually my mom can do both of those, but . . .*
>
> *I don't think, based on like my personal experience, I feel like they didn't, like my experience didn't prepare me for this game, because this game was unique itself. It was meant to train you and prepare you to answer and test people to see if they're lying or not. So, I think the purpose of it and the uh, strategy was different which is why I felt like it didn't prepare me.*
>
> *I just don't know if they'd understand how to use the technology, I mean obviously they could learn if they want to, but I think they'd be more used to, I don't know, reading from books or something like that, but I mean, it's up to them.*

Similarly, one of the officers also mentioned a comment that contributed to this theme. He asserted that perhaps someone who had not grown up in a digital age may see the technological aspect of DGBL to be a barrier and this might cause an unwillingness to learn. The following exemplary comment from an officer highlights this theme:

> *Um, so my parents, no cell phone ever, like ever. And just they don't really see themselves as people who want to or need to, for the lack of better words, get on board, or kind of use technology in the way that most people do, they're quite the opposite. So, they would probably definitely shy away from something like Veritas, in the sense that, they'd probably participate, with encouragement, but they wouldn't probably, they wouldn't see the value necessarily.*

Overconfidence. A last theme that emerged spoke to the influence of a person's perceived level of pre-existing knowledge on the topic of deception detection and how it contributed to a sense of overconfidence when they first began playing VERITAS (20 comments). Comments in this area indicated that students believed they had a good foundation of knowledge about the topic of deception detection prior to playing. However, throughout the course of the game, they realized that their foundation of knowledge was based on inaccurate information. As a result, participants had to work to overcome their pre-existing stereotypes about deception. The following exemplary comments from students highlight this theme:

> *Yeah like I said earlier, I think I was just too confident at first and I wasn't taking feedback as much as I should have. So, if I could do it again I would probably read it thoroughly and apply it.*

> *I guess I came in a little cocky, because I thought the same thing as her, that those were key things in deception, and then when I got it wrong I wasn't like "I'm shocked" it was like "No, I'm still right, you're wrong, I'll just do it again."*

> *I also think I was a little overconfident in some answers because of my prior beliefs …. For like certain things like the nervousness and stuff. But after I got one wrong I just realized that's definitely not what we're looking for.*

Similarly, two of the police officers also discussed the impact that their prior-knowledge on deception detection had on learning from VERITAS. The following exemplary comments from officers highlight this theme:

> *Um, just falling into the traps and the assumptions, and not really focusing on the, kind of that bigger picture, particularly with eye contact, looking away, all the things that sometimes are, you know, kind of out there as a standard belief, oh if somebody's not making eye contact...so you know, watching those things, or the fidgeting necessarily, maybe somebody just being nervous, then when they stopped, I thought, oh of course, people often times if you're in a police department, you're nervous, as I would be, you know? But that has nothing to necessarily do with your ability to tell the truth or be truthful. So just kind of stopping and thinking about it, and uh, that's why the tutorial was really good, because it really kind of hones in, and I think a lot of people would hopefully go do better. As I found myself getting a lot more comfortable, with the scenario and being able to detect.*

> *Yes, I think so, again it was eye contact, breaking away, the fidgetiness of a person moving, things like that, and learning that, and again in my personal experiences, in a flow of a conversation, I have known those to be detectors. But again, I don't have the statistical data that you guys are doing here, which I think is great, but it always feels like somebody, like answering simple questions like what their name is or their*

date of birth, where they live, their phone number, then you start asking them questions about, well were you here at this person's house, what were you doing here, things like that, and when you saw them kind of closing off, getting fidgety or looking away, trying to think of an answer, those things that you just key in on to see where I need to probe down a little bit more. But uh, learning that, that's not always what you should be looking for, there's probably other indicators that vagueness, repeating the question, and using negative language, I learned something, I really did.

Summary on knowledge. Overall, participants indicated that the VERITAS game itself exhibited an intuitive and user-friendly design that most anyone could easily adapt to regardless of existing knowledge and skills in video games. Nonetheless, a small subset of the participants indicated that some people may find the technological aspect of a digital game-based training to be a barrier. This might impact a person's achievement in DGBL in a negative way. Regarding content knowledge, a person who has inaccurate pre-existing knowledge on the topic of deception detection may struggle with learning new content at first due to overconfidence, but participants indicated that they were still able to learn the new material. Thus, based on responses from the focus groups and interviews, the impact of student knowledge of game-play and content knowledge of deception may not play a large role in impacting participant learning in the context of a DGBL program such as VERITAS.

Summary

This report discussed findings and insights as revealed from focus group and interview participants in describing the ways five SCFs predicted learning and motivation in DGBL. Fifteen emergent themes were organized according to the following codes: for interest: (1) absent game mechanics and (2) helpful game mechanics. For beliefs: (3) games help learning and (4) games do not help learning. For goals: (5) competition; (6) topic learning; (7) narrative enjoyment; and (8) hurried finish. For needs: (9) entertainment seeking; (10) escapism; (11) socializing; and (12) entertainment lacking. For knowledge: (13) intuitive design; (14) hypothetical challenges; and (15) overconfidence.

Several key findings are synthesized from this analysis. First, participants found that VERITAS did not function like a standard entertainment type of video game; instead they viewed it as a training simulation. In tension with this view, they still thought the game-like features were beneficial for learning. Second, participants had mixed beliefs on the degree to which video games could work as effective teaching tools. Third, students demonstrated a variety of goals when engaging in video games and game-based learning. Fourth, if participants play a game to have fun, but a game is not fun, the game will not be motivating. Lastly, although most people agreed that VERITAS itself is easy to play, there is still a looming idea that some people might struggle and see the digital component as a barrier.

From these responses, it can be presumed that not all five SCFs in this study will play a large role to predict learning and motivation in a DGBL program like VERITAS. It is likely that student interests and knowledge will play a weaker role. However, student beliefs, goals, and needs may play a stronger role in impacting learning and motivation. This does not change the hypotheses as originally proposed from the literature review; rather it provides additional observations for this study, which can be used to assist interpretation of the final data from the main experiment. According to Myers (2014), an important feature of mixed-method research is that the data is integrated together to address research questions that produce greater insights in interpretation than either method could produce alone. As such, the insights revealed in Study II begin to explore the ways SCFs may predict learning and motivation, but a full interpretation will be offered following the results of the main experiment.

V. Study III: Main Experiment

Method

The goal of Study III was to test the influence of five pre-existing student-centered factors (SCFs; interest, beliefs, goals, needs, & knowledge) on learning in digital games in general and in relation to the specific learning topic of interest (deception detection). This study used a pretest-posttest experimental design to assess the influence of SCFs on learning and motivation in DGBL. As one part of a larger NSF funded project, additional procedures, tasks, and measures were used; however, this report focusses on the procedures, tasks, and measures relevant to the dissertation hypotheses.

Participants

Volunteer participants (N = 510 valid cases) included college students enrolled across three large universities located in the western (n = 146), midwestern (n = 221), and southeastern (n = 143) United States. Students received a nominal amount of course credit and a $10 gift card for participation. Participants were 70.8% females and 26.9% males (2.3% did not report their sex) with a mean age of 19.83 years (SD = 2.2). Participants represented a variety of student levels: 23.5% first-years, 31.8% second-years, 29% third-years, 9% fourth-years, 2.5% fifth-years, and 2.2% graduate students (2% did not indicate year in school). Regarding ethnicity, 4.9% were Black/African American, 56.5% were Caucasian/white, 10% were East Asian, .2% were an Indigenous/Aboriginal, 16.7% were Latina/o, 3.7% were multiracial, 1.4% were Middle Eastern/Arabic, 2% were South Asian/Indian, and 2.7% reported ethnicity as “other” (2% did not indicate ethnicity). Lastly, 80.2% reported that English was their first language and 17.8% reported that English was not their first language (2% did not indicate a first language).

Procedure

First, participants volunteered for this study online and a link to a 30-minute self-administered online pretest (pretest part I) was emailed to participants with instructions to complete the pretest before arriving at the lab. Second, upon lab arrival, subjects completed further pretest materials (pretest part II) designed to assess their baseline knowledge in deception detection immediately prior to engaging in a designated training program. Third, participants completed a deception detection training in the form of either a digital game (VERITAS) or a PowerPoint lecture (PPT; described in the lab procedures below). Lastly, participants completed posttest measures after the training.

Online pretest (part I) procedure. The pretest was divided into two separate questionnaires completed by participants at different times to reduce the degree that they experienced fatigue from attending an extended laboratory study (2.5 credit hours assigned to students for completion). Part I of the pretest questionnaire was emailed to participants, allowing for online completion at their convenience prior to arrival in the lab. On average, subjects completed the pretest in 1.92 hours (*Mdn* = 10 minutes).[1] This online pretest (part I) included the following components: first, participants completed a consent form, which informed them of the procedures and the confidentiality of their data. Next, participants entered their campus location and a designated ID number used to match pre- and post-questionnaire data. Participants then completed the following five measures in order: *Experience with Gaming; Student-Centered Factors; Trait Reactance;* and *Outcome Relevant Involvement.* Out of these measures, this dissertation analyzes the variables

[1] Although the average amount of time participants spent in the online pretest was 1.92 hours, examining the frequency statistics shows that the median completion time was 10 minutes (*SD* = 11.6 hours). 39 participants left their online survey open for longer than an hour before submitting their final responses. However, all completed presurvey responses were retained in the final dataset because pretest part I measures were not time sensitive.

measured by the *Student-Centered Factors* scale only; the other four measures are analyzed elsewhere for reporting in the larger NSF funded project. Lastly, participants completed questions about their *Demographics*.

Laboratory pretest (part II) procedure. After completing the online pretest measures, participants attended a designated lab appointment at a pre-scheduled time. On average, subjects completed the online pretest within 3.32 days (*SD* = 4.9 days) before their laboratory appointment.[2] Laboratory participation experienced a 19% attrition rate between the online pretest part I (*n* = 634) and laboratory test procedures (*n* = 513). A small number of participants (*n* = 9) completed the laboratory procedures without completing the pretest; thus, their data could not be matched to the pretest measures. Nonetheless, the data for participants that could not be matched to pretest scores was retained to examine hypotheses unrelated to measures tested in the pretest. The average amount of time participants spent completing all laboratory procedures was 2.64 hours (*Mdn* = 1.66 hours).

To begin lab procedures, participants entered their campus location and designated ID number so that pretest part I and lab data could be matched correctly per subject. Next, participants completed a *Deception Detection Skills* test and a *Deception Detection Knowledge* test to measure their baseline deception detection skills and knowledge prior to training (pretest part II). Following the two deception detection tests, subjects were randomly assigned to complete a *Self-Affirmation* task and *Self-Affirmation Induction Check*, both of which are reported on and analyzed within the larger NSF funded project results only. However, it is worth mentioning that the *Self-Affirmation* manipulation was

[2] The earliest online pretest was completed on October 4, 2016 and the earliest laboratory posttest was completed on October 6, 2016. The last online pretest and laboratory posttest were both completed on December 9, 2016. Data collection lasted approximately 2 months.

ineffective and did not induce different levels of self-affirmation between participants.[3] Thus, subjects were not impacted by the self-affirmation task overall, and this measure is not used in subsequent analyses.

Deception detection training. After finishing the lab pretest procedures, participants completed one of two possible deception detection trainings; either the VERITAS game or PPT training lecture. Each laboratory session was designed so that all participants during the same timeslot completed the same type of training in the same computer room. Further, the type of training alternated between every scheduled session timeslot (i.e., session time 1 completed VERITAS; session time 2 completed PPT, etc.) This procedure was followed to be certain that participants were not aware that alternate training types were available to other participants. Total participants for the VERITAS training resulted in a number of subjects that was somewhat higher (n = 273 valid cases) than the number of participants who attended the PPT lecture training sessions (n = 237 valid cases). This occurred because after a sufficient number of participants was obtained for comparison between the VERITAS and PPT conditions, additional data were collected seeking only VERITAS participants in order to obtain a sufficient number of subjects per cell for the analysis of data used within the larger NSF funded project.

At the start of both training types, participants were randomly assigned to be in a condition in which the training instructions were designed to induce a low or high degree of *Reactance* (threat to freedom): this variable was analyzed for reporting within the larger NSF funded project only. However, the *Reactance* manipulation was also ineffective and did not

[3] An Independent samples t-test examined the effectiveness of the self-affirmation manipulation and indicated that participants in the low self-affirmation group (M = 5.29, SD = 1.02) were not significantly different than those in the high affirmation group (M = 5.30, SD = 1.09), $t(508) = .13$, $p = .89$.

induce different levels of reactance.[4] Thus, subjects were not impacted by the reactance manipulation overall, and this measure is not used in subsequent analyses.

VERITAS training game. As mentioned previously, VERITAS is a game-based training program designed specifically to teach deception detection knowledge and skills. Mandatory play-time within VERITAS lasts approximately one hour. In VERITAS, players (n = 273) work through two scenarios, and in each scenario, assess when an actor in a hypothetical story is lying or telling the truth. In scenario 1, players interview a job applicant to assess whether she is trustworthy; in scenario 2, players interrogate a suspect to evaluate whether she engaged in theft. Both scenario actors feature demographic qualities representative of college-aged, white, females to reduce confounding variables (for a full review of how VERITAS functions, see Chapter IV). In total, the game has 36 mandatory and 78 total interview questions (42 questions are optional) that participants can ask to practice their deception detection knowledge and skills. On average, users in this study asked 53 questions each (SD = 13) with 12 users asking all 78 questions; the average amount of time users spent in game was 54:51 (SD = 10:24) minutes.

PowerPoint training lecture. A PowerPoint (PPT) training lecture presentation was created for this study to represent a more traditional form of educational training (run-time is 13 minutes). In this training, participants (n = 237 valid cases) watch a PPT video that includes text, pictures, and sound narrated by the same university professor featured in VERITAS (see Figure 2 for PPT images).

[4] An Independent samples t-test was performed to examine the extent to which the manipulation induced low or high degrees of reactance in the correct direction. Participants in the low reactance group indicated a similar level of *Threat to Freedom* (M = 1.79, SD = .81) as participants in the high reactance group (M = 1.80, SD = .89) with no significant differences between groups $t(507) = .24$, $p = .81$. Similarly, participants in the low reactance group indicated a similar level of *Negative Affect Reactance* (M = 1.33, SD = .57) as participants in the high reactance group (M = 1.34, SD = .53) with no significant differences between groups $t(507) = .37$, $p = .71$.

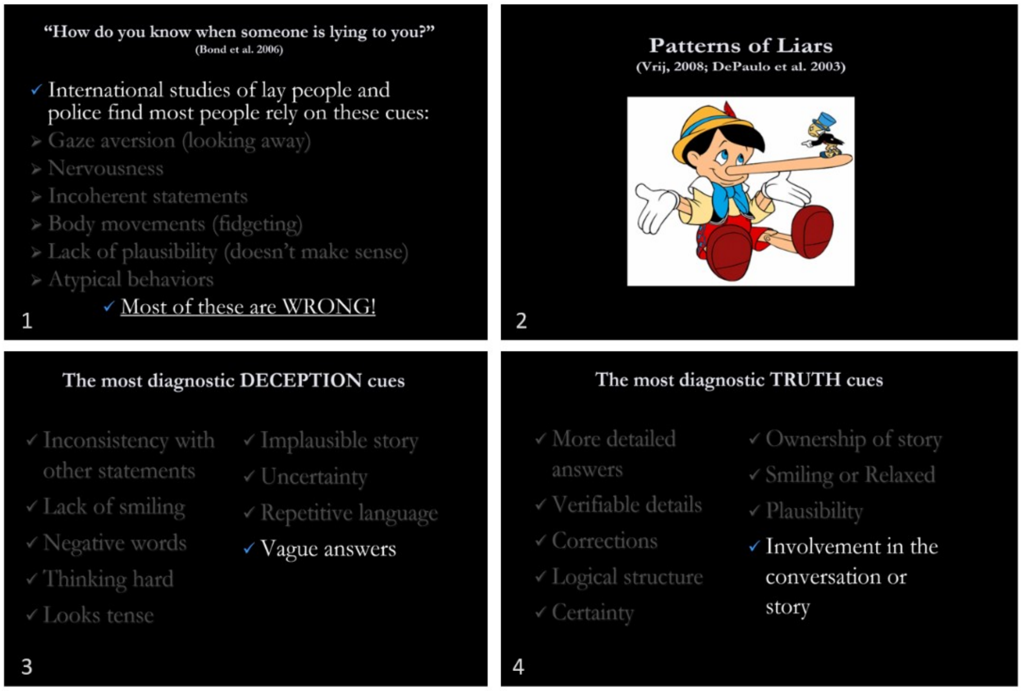

Figure 2. Four images are shown from the PowerPoint training. Quadrant 1 shows misperceptions; quadrant 2 shows an in-training image; quadrant 3 shows deception cues; quadrant 4 shows truth cues.

The PPT describes similar lecture content that is taught in the VERITAS game regarding reliable truth cues, reliable deception cues, and unreliable stereotypical cues (see Chapter I for a review). When participants view the presentation, there is no interactivity, playing, or feedback; therefore, the length of time for the PowerPoint training is shorter (13 minutes vs. 1 hour) in comparison to play-time afforded to users in VERITAS. Nonetheless, the educational content between the two programs is equivalent. As mentioned previously (see Chapter II for the literature review) Eveland's (2003) mixed attribute approach can be used to summarize the ways these two media differ. The PPT training uses a high degree of textuality, a low degree of engagement with additional sensory channels, a low degree of interactivity, a low degree of control, and a low degree of time. In comparison, VERITAS uses a high degree of textuality, a high degree of engagement with additional sensory channels, a high degree of interactivity, a high degree of control, and a high degree of time.

Posttest procedure. Following the deception detection training, participants completed a posttest questionnaire. The posttest began with a reactance induction check that measured both *Threat to Freedom* and *Negative Affect Reactance*; both variables were used to assess the degree of reactance participants experienced from the manipulation as tested in the larger NSF funded project only; however, this manipulation was ineffective and had no impact on participants;[4] thus, these measures are not used in subsequent analyses.

Next, participants completed a second *Deception Detection Knowledge* test to examine the extent participants learned deception detection related knowledge from the designated training. Participants then completed the following five outcome measures in order: *Cognitive Appraisal; Cognitive Absorption; Intrinsic Motivation; Deception Detection Activity Motivation;* and *Outcome Relevant Involvement.* Out of these five measures, only *Intrinsic Motivation* and *Deception Detection Activity Motivation* are analyzed in this report; the remaining three measures are analyzed elsewhere for the larger NSF funded project. Lastly, participants completed a post *Deception Detection Skills* test to further assess the degree that they learned deception detection related skills from the designated training. To reduce the likelihood that a subject's primed perceived knowledge (from taking the knowledge test) could impact their subsequent performance on the skills test, outcome measures were placed between the two types of deception detection tests to create a sense of psychological distance between them. However, the skills test was not included in the final analysis of this report (see explanation in the measures section below).

Because this experiment was performed as one part of the larger NSF funded project, a variety of measures, procedures, and hypotheses have been reviewed and described. However, as noted previously, this dissertation focusses only on the measures specifically of interest to this study's hypotheses. To clarify the final measures utilized here, Figure 3 depicts a visual summary of the predictor variables and outcomes variables of interest.

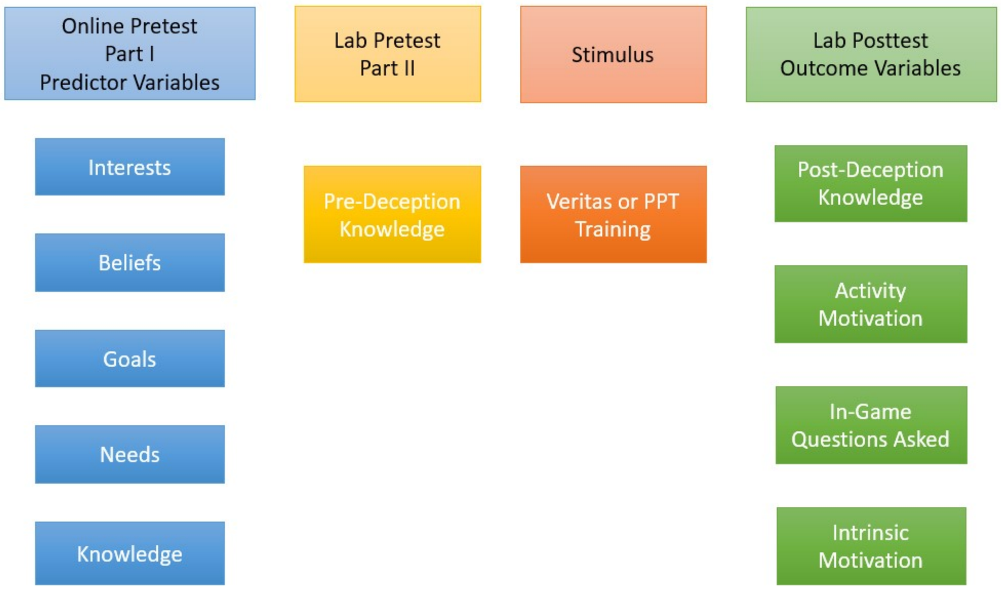

Figure 3. A visual summary outlines the pretest and posttest measures in this dissertation. The 5 predictor variables (SCFs) are used to predict the 4 outcome variables: post-deception knowledge, activity motivation, in-game questions asked, and intrinsic motivation. However, rather than examining post-deception knowledge as a single outcome variable, the pretest deception score is subtracted from the posttest deception detection score to obtain a knowledge test difference score that is used in analysis.

Measures for the Online Pretest (Part I)

For a complete listing of all measures and the individual items that were used to test the hypotheses in this dissertation as they appeared in the pretest and posttest materials, see the appendices. Only items relevant to the dissertation project are included in the appendices and explained below.

Student interests. A *student interests* measure was adapted to examine whether students' prior interests predicted outcome variables. This scale was composed of two subscales: (1) *student interest toward games* and (2) *student interest toward deception*. Both were measured using 3 Likert-scale items each (ranging from 1 – 7; "strongly disagree" to "strongly agree"). An example item from the interest in games scale includes "I'm interested in learning new information from playing a video game." The reliability was acceptable for both the interest in games scale (α = .88, *M* = 4.06, *SD* = 1.80) and the interest in deception scale (α = .88, *M* = 5.11, *SD* = 1.36).

Student beliefs. A *student beliefs* measure was adapted to examine whether students' prior beliefs predicted outcome variables. This scale was composed of two subscales: (1) *student beliefs toward games* and (2) *student beliefs toward deception*. Both were measured using 3 Likert-scale items each (ranging from 1 – 7; "strongly disagree" to "strongly agree"). An example item from the beliefs in games scale includes "I believe I can learn something useful from a video game." The reliability was acceptable for both the beliefs in games scale (α = .87, *M* = 4.31, *SD* = 1.66) and the beliefs about deception scale (α = .71, *M* = 5.54, *SD* = 1.24).

Student goals. A *student goals* measure was adapted to examine whether students' goals predicted outcome variables. This scale was composed of three subscales: (1) *approach oriented goals;* (2) *mastery oriented goals;* and (3) *avoidance oriented goals.* Each was measured using 4 Likert-scale items (ranging from 1 – 7; "strongly disagree" to "strongly agree"). An example item from the approach oriented goals scale includes "My goal when playing a video game is to perform well so others will know how capable I am." The reliability for these subscales is reported as follows: (1) approach oriented goals: acceptable (α = .75, *M* = 4.00, *SD* = 1.63); (2) mastery oriented goals: acceptable (α = .71, *M* = 4.90, *SD* = 1.52); (3) avoidance oriented goals: unacceptable (α = .62, *M* = 4.03, *SD* = 1.56). Although the internal consistency of the avoidance oriented scale was not acceptable, the scale was not improved by removing any number of the items. This subscale was not ideal, however, rather than completely removing the subscale from analysis, it was maintained as a 4-item measure to explore this variable.

Student needs. A *student needs* measure was adapted to examine whether student needs predicted outcome variables. This scale was composed of two subscales: (1) *student needs regarding games* and (2) *student needs regarding deception*. Both were measured using 3 Likert-scale items each (ranging from 1 – 7; "strongly disagree" to "strongly agree"). An example item from the needs in games scale includes "When I play a video game, I feel like I'm able to satisfy some of my own personal needs." The reliability was acceptable for both the needs regarding games scale ($\alpha = .90$, $M = 3.53$, $SD = 1.87$) and the needs regarding deception scale ($\alpha = .79$, $M = 4.95$, $SD = 1.36$).

Student knowledge. A *student knowledge* measure was adapted to examine whether students' prior knowledge predicted outcome variables. This scale was composed of two subscales: (1) *student knowledge about games* and (2) *student knowledge about deception*. Both were measured using 3 Likert-scale items each (ranging from 1 – 7; "strongly disagree" to "strongly agree"). An example item from the knowledge in games scale includes "Based on my previous video game knowledge, I feel prepared to learn how to play a new video game." The reliability was acceptable for the knowledge about games scale ($\alpha = .89$, $M = 3.99$, $SD = 1.90$), but unacceptable for the knowledge about deception scale ($\alpha = .65$, $M = 4.49$, $SD = 1.39$). However, the reliability was not improved by removing any single item. Although this subscale was not ideal, rather than completely removing the subscale from analysis, it was maintained as a 3-item measure to explore this phenomenon.

Measures for the Lab Pretest (Part II)

Outcome-focused motivation. According to Touré-Tillery and Fishbach (2014), outcome-focused motivation refers to a drive to complete a goal. To assess outcome-focused motivation, scholars often use cognitive measures. Cognitive measures are used when examining the ways that goals are organized in one's associated memory in relation to other similar constructs. Tests of recall can be used to examine this relationship: if a learner is taught 10 new vocabulary words and he or she is able to recall all 10, this indicates a higher level of motivation to do well in the activity. As such, a deception detection knowledge test was used to measure learning between the pre- and posttest as well as a representation of outcome-focused motivation (see Table 4).

Deception detection knowledge test. A *Deception Detection Knowledge* test was created to examine participants' pre- and posttest knowledge in identifying truth and deception cues. In the pretest, participants were randomly assigned to answer 5 out of 10 possible multiple choice and true/false questions about deception detection knowledge. In the posttest, subjects again answered 5 out of 10 questions (phrased differently as variants of the questions in the pretest). In both the pretest and the posttest, a correct answer on the deception detection knowledge test was worth 1 point. Therefore, students could achieve 0 to 5 points during the knowledge pretest and 0 to 5 points for the knowledge posttest so that the average scores achieved could be compared between the two tests (Appendix D). Pretest scores in deception detection knowledge ($M = 2.09$, $SD = 1.10$) were significantly different from posttest scores ($M = 3.77$, $SD = .98$), $t(509) = 125.28$ $p < .001$, $r = .75$.

A pretest-posttest method was selected to assess learning before and after the training. This method is useful because it allows researchers to examine a baseline knowledge score. Thus, differences in learning between time 1 and time 2 could be assessed. However, a disadvantage of pretest-posttest designs is that participants may become sensitized to the testing material (Singleton & Straits, 2010). To manage this issue, the questions in the posttest and pretest were not identical; they were variants of each other. For example, a sample question from the pretest includes: "Spontaneous corrections happen when a speaker corrects his/her own mistakes while talking. They are used more by truth tellers than deceivers. True or False?" Whereas a sample question from the posttest includes: "What are spontaneous corrections? (A) Someone catches you lying and fact-checks you on the spot; (B) A speaker corrects his/her own mistakes while talking; (C) A speaker includes details in their statements that can be verified; (D) None of these options." This helps to alleviate the redundancy of having identical test questions to avoid sensitization.

Although one could argue that the true/false questions may be easier given that participants have a 50% chance of getting them right, there was an equal number of true/false questions in both the pretest and posttest. Given the randomization of test questions in both the pre- and posttest, this worked to prevent systematic bias. In addition, Singleton and Straights (2010) posit that "In educational settings, where task taking is the norm, the effects of a testing-treatment interaction would probably be negligible" (p. 239). Because recall tests are a standard component of classroom tests and procedures, there is likely no reason to suspect that the pre- knowledge test impacted posttest responses.

To assess the degree that participants learned between the pretest and posttest in the subsequent analyses and to serve as a representation of outcome-focused motivation, *difference scores* were calculated by subtracting pretest scores from posttest scores for deception detection knowledge. Thus, for all analyses that examine outcome-focused motivation, the difference scores for knowledge in deception detections cues were utilized (see Table 4 for a summary of outcome measures for each motivation dimension).

Deception detection skills test. A *Deception Detection Skills Test* was created to examine a participant's pre- and posttest skills in accurately identifying truths and deceptions in videos showing authentic truth-tellers and liars. In the pretest (and as one portion of the experimental condition not tested in this particular dissertation), participants were randomly assigned to view one set of videos (out of two sets available) that included 4 videos; each of the 4 videos was presented in random order. In the posttest, participants viewed the second set of 4 videos; each of the 4 videos again presented in random order. The two 4-video sets (labeled A and B) were randomly counterbalanced between pre- and posttest, so that roughly half the participants (n = 267) received set A as their pretest with the set B as their posttest; the other half (n = 243) received set B as their pretest with set A as their posttest. Both video sets contained 2 truth-teller videos and 2 deceiver videos; each individual video varied in length between 1:48 minutes to 6:40 minutes. Combined, each 4-video set lasted approximately 17 minutes each.

The videos were generated during a previous study (Dunbar et al., 2015) that examined truth-teller and deceiver strategies used when discussing the likelihood of cheating in a trivia game. Because the trivia game contained a monetary reward, participants were motivated to cheat (to earn more points in the trivia game) and to lie about their cheating behavior. The interviews in each video were conducted by professional deception detection intelligence analysts and the videos contained the same segment of questions. After watching each video, participants assessed whether the speaker was lying or not.

The skills test was developed specifically for testing in the larger NSF study only; as such, analysis of the dissertation hypotheses was not designed to examine the results of this test. Nonetheless, it is worth noting that two primary issues occurred that prevented the skills tests from functioning as a valid assessment of training. First, two of the truth videos were judged incorrectly (as deception videos) significantly more often during the posttest than during the pretest. This effect was not the result of video length, as the two videos were not the longest in the set. As a result, these two videos were removed from the skills test.

This created an additional problem: with two videos missing, the skills tests lacked variability. Participants could rate only 1 truth video during the pre- and posttest.

Additionally, coding of the skills tests videos was performed after the experiment to assess the types of cues that were used by the truthtellers and deceivers in the authentic videos. Results indicated that the truthtellers and deceivers in the videos did not exhibit the types of research-based cues that were taught in the deception detection training. This issue could be the result of a disconnect between research-based cues of truth/deception and the way users enact these cues in authentic truth-telling and deceiving interactions. However, this issue goes beyond the scope of the hypotheses proposed in this dissertation. In summary, the skills test was not used in the following analyses for two primary reasons: (1) the hypothesis of interest in this study were not seeking to examine transferable skills; (2) the skills test measure was shown to be invalidated in testing.

Measures for the Posttest

Process-focused motivation. Touré-Tillery and Fishbach (2014) define process-focused motivation as the drive toward attending to the process of completing a goal. To assess process-focused motivation, scholars often use affective measures. Affective measures are used when examining a participant's subjective evaluations in relation to the goal. To examine subjective evaluations, researchers can ask participants to complete self-report measures to describe their experiences. If a participant evaluates a task positively, this indicates a higher level of motivation. To measure process-focused motivation, a deception detection *activity motivation scale* was utilized to examine participant experiences (see Table 4 for a summary of outcome measures for each motivation dimension).

Activity motivation. Pelletier et al. (1995) examined the context of sports motivation and found that a related set of variables positively influenced motivation: (1) *knowledge* acquisition (i.e., learning new information about the task); (2) *accomplishment* (i.e., doing the task well); and (3) *stimulation* (i.e., enjoying the experience). Using these variables summed into a composite measure, an activity motivation measure was adapted from Pelletier et al., (1995) to examine a person's process-focused motivation for engaging in the deception detection activity training with regards to perceived satisfaction and pleasure in learning about deception. This measure included 11 Likert-type items (ranging from 1 – 7; "Does not correspond at all" to "corresponds exactly"). An item example that falls within the stimulation domain of the measure includes: "For the pleasure I feel in the experience." The reliability for this scale was high ($\alpha = .93$, $M = 4.44$, $SD = 1.60$) (Appendix F).

Means-focused motivation. According to Touré-Tillery and Fishbach (2014), a more specific type of process-focused motivation is means-focused motivation. Means-focused motivation is defined as the drive toward using proper methods in the process of completing a goal. To assess means-focused motivation, scholars often use behavioral measures that are designed to examine a person's observable actions during the process of completing a goal to assess the degree to which actions match appropriate types of behavior suitable for the task. For example, if a learner is required to answer at least 5 out of 10 questions, but the learner answers all 10 questions, this indicates higher means-focused motivation. As such, this measure examines participant in-game behavior when playing VERITAS. As mentioned, the game has 36 mandatory and 78 total interview questions (42 questions are optional) that participants can ask to practice their deception detection knowledge and skills. On average, users in this study asked 53 questions each ($SD = 13$) with 12 users asking all 78 questions. Therefore, participants who ask more questions are engaging appropriately with the task and are indicating a higher level of means-focused motivation (see Table 4 for a summary of outcome measures for motivation dimensions).

Intrinsic motivation. Lastly, Touré-Tillery and Fishbach (2014) describe another specific type of process-focused motivation: intrinsic motivation. Intrinsic motivation is defined as the drive toward enjoying the process of completing a goal. Just as in the case of the measure utilized to assess process-focused motivation as discussed previously, intrinsic motivation can also be measured with affective measures that examine a participant's subjective evaluations. Although questions from the process-focused and intrinsic motivation overlap, process-focused motivation represents a broader form of motivation in attending to a task while the intrinsic motivation measure in this study represents specific dimensions. As such, an *Intrinsic Motivation Scale* (McAuley, Duncan & Tammen, 1987) was adapted for this study. This scale was composed of the following *5* subscales: *interest/enjoyment*; *perceived competence*; *effort/importance*; *perceived choice*; and *value/usefulness*. For every subscale in the intrinsic motivation measure, variability of response options ranged from 1 – 7; "strongly disagree" to "strongly agree" (Appendix G).

Interest/enjoyment. This measure included 7 Likert-type items. An item example includes: "I enjoyed doing this activity very much." The reliability for this scale was high ($\alpha = .94$, $M = 4.78$, $SD = 1.50$).

Perceived competence. This measure included 4 Likert-type items. An item example includes: "I think I am pretty good at this activity." The reliability for this scale was high ($\alpha = .90$, $M = 4.71$, $SD = 1.37$).

Effort/importance. This measure included 4 Likert-type items. An item example includes: "I put a lot of effort into this." The reliability for this scale was high ($\alpha = .86$, M = 5.16, SD = 1.44).

Perceived choice. This measure included 5 Likert-type items. An item example includes: "I felt like it was not my own choice to do this task." Questions indicating a lack of choice were recoded as appropriate. The reliability for this scale was high (α = .84, *M* = 4.59, *SD* = 1.81).

Value/usefulness. This measure included 4 Likert-type items. An item example includes: "I believe this activity could be of some value to me." The reliability for this scale was high (α = .93, *M* = 5.76, *SD* = 1.09).

Table 4

Summary of Motivation Outcome Measures

Motivation Dimension	***Definition***	***Type of Measure***	***Outcome Assessed***
Outcome-focused motivation	A drive to complete a goal	Cognitive	Deception detection knowledge difference scores (pre- and post)
Process-focused motivation	Attending to the process of completing a goal	Affective	Activity motivation: knowledge, accomplishment, & stimulation (post)
Means-focused motivation	Using proper methods in the process of completing a goal	Behavioral	The amount of in-game questions asked (stimulus)
Intrinsic motivation	Enjoying the process of completing a goal	Affective	Intrinsic motivation: enjoyment, competence, effort, choice, value (post)

Results

This report utilizes statistical software SPSS version 24 to analyze all data tested within the predicted hypotheses. Because there are multiple hypotheses that utilize similar variables and analyses, Table 9 is presented at the end of this section to clearly summarize the outcome of each hypothesis. In overview of this analysis, hypothesis 1 focuses on the learning outcomes for all participants (N = 510) to compare learning by training type; this includes both users who played the training game (n = 273) and users who watched the PPT lecture (n = 237). Analysis for H_1 examines the pretest and posttest data for the deception detection knowledge scores, using a repeated measures analysis of covariance.

After the reporting of H_1 results, all remaining hypotheses focus exclusively on the participants who played the training game (n = 273) to examine the influence of SCFs on motivation when playing VERITAS. To measure the degree that participants learned between the pretest and posttest for H_2 through H_{12}, difference scores were calculated by subtracting pretest scores from posttest scores for the deception detection knowledge test. The difference scores are used for analyses of outcome-focused motivation (i.e., learning).

Learning across Time and Media Outcomes

Hypothesis 1 predicted that, in comparison to users who watch a PPT training lecture, users who play the digital training game, VERITAS, will exhibit greater learning in deception detection knowledge. To examine the interaction of time (between the pretest and posttest knowledge test) with training condition, a repeated measures factorial ANCOVA was conducted with pretest scores entered as time 1, posttest scores entered as time 2, training condition (VERITAS vs. PowerPoint) entered as the first between-subjects factor, and institution (university) entered as the second between-subjects factor. Institution was included to examine any potential differences between groups within the student populations that were located at Universities separated in geographical distance. This test also examined 14 covariates to control for demographic variables (gender; ethnicity; and first language) and SCFs (interests in games; interest in deception; beliefs in games; beliefs in deception; approach goals; mastery goals; avoidance goals; needs in games; needs in deception; pre-existing knowledge in games; and pre-existing knowledge in deception).

Results from the within-subjects analysis of this initial model showed a significant main effect for time $F(1, 480) = 13.44$, $p < .001$, $R^2 = .027$ and a significant interaction between time and one of the covariates: first language $F(1, 480) = 14.17$, $p < .001$, $R^2 = .029$. There was no significant interaction for training type $F(1, 480) = .41$, $p = .521$, $R^2 = .001$ or institution $F(1, 480) = .21$, $p = .122$, $R^2 = .009$. Results from the between-subjects initial analysis model showed a significant main effect for first language $F(1, 480) = 4.39$, $p = .037$, $R^2 = .009$ and a significant main effect for training type $F(1, 480) = 6.43$, $p = .012$, $R^2 = .013$. However, there was no main effect for institution $F(2, 480) = .73$, $p = .482$, $R^2 = .003$. Given these results, the model was reparametrized and reanalyzed with institution removed as a factor and all non-significant covariates removed.

In the reparametrized analysis, a repeated measures factorial ANOVA was conducted with pretest scores entered as time 1, posttest scores entered as time 2, training condition (VERITAS vs. PPT) entered as the between subjects factor, and first language entered as a second factor (English vs. English as a second language). Rather than including first language as a covariate, first language was entered as a second between-subjects factor to further examine the interaction of training type and first language as grouping variables. Mean pretest and posttest scores for the final model analysis of knowledge in deception detection are summarized in Table 5.

Table 5

Means for Pre- Post- Deception Detection Knowledge

			Pretest		**Posttest**	
		N	***MN***	***SD***	***MN***	***SD***
Veritas	Eng. 1st lang.	222	2.08	1.10	3.91	0.82
	Eng. 2st lang.	48	2.42	1.01	3.65	0.98
	Total	270	2.14	1.09	3.86	0.85
PPT	Eng. 1st lang.	187	2.05	1.11	3.83	1.00
	Eng. 2st lang.	43	2.02	1.12	2.88	1.26
	Total	230	2.04	1.11	3.65	1.11
Total	Eng. 1st lang.	409	2.06	1.10	3.87	0.90
	Eng. 2st lang.	91	2.23	1.07	3.29	1.18
	Total	500	2.09	1.10	3.77	0.98

Results from the final model within-subjects test show a significant main effect for time, with improvement in scores between the pretest and posttest regardless of training type, $F(1, 496) = 275.33$ $p < .001$, $R^2 = .357$. Within-subjects tests also showed an interaction between time and first language, $F(1, 496) = 19.67$, $p < .001$, $R^2 =.038$. There was no interaction between time and training condition, $F(1, 496) = 1.50$, $p = .221$, $R^2 =.003$. There was also no interaction between time, training condition, and first language, $F(1, 496) = .85$, $p = .358$, $R^2 =.002$.

Nonetheless, results from the final between-subjects tests showed a significant main effect for first language, $F(1, 496) = 7.38$, $p = .007$, $R^2 =.015$, a main effect for training type, $F(1, 496) = 14.78$, $p < .001$, $R^2 =.029$, and an interaction between training type and first language, $F(1, 496) = 10.11$, $p = .002$, $R^2 =.020$. Therefore, between-subjects' analyses indicated that, in comparison to users who watch a PPT training lecture, users who played VERITAS exhibited a small degree of higher learning in deception detection knowledge between time 1 and time 2 (with differences in learning higher by .11 on a 5-point scale for the VERITAS condition). This is especially the case for users who indicated that their first language was not English, as they showed a stronger improvement in the training game condition (with differences in learning higher by .37 on a 5-point scale for the VERITAS condition) in comparison to their scores in the PPT condition. Thus, H_1 was supported.

SCFs as Predictors of Motivational Outcomes

For the remaining hypotheses, H_2 through H_{12}, a simple linear regression was conducted to test the relationship predicted by the SCF explanatory variables for each of the four outcome variables: (a) outcome-focused; (b) process-focused; (c) means-focused; and (d) intrinsic motivation. Each set of results reports the standardized β, the t-ratio, and the significance level. Table 9 summarizes the results of each of hypothesis test and Table 7 summarizes all beta coefficients (standardized bivariate correlations) for H_2 through H_{12}.

Interest in games. H_2 predicted that, for users playing a training game, higher interest in digital games would predict higher scores on measures of: (a) outcome-focused; (b) process-focused; (c) means-focused; and (d) intrinsic motivation. Results show that interest in games was a significant predictor for process-focused motivation, $\beta = .19$, $t(267) = 3.12$, $p = .002$; and means-focused motivation, $\beta = .22$, $t(199) = 3.17$, $p = .002$. However, interest in games was not a significant predictor for outcome-focused motivation, $\beta = .06$, $t(268) = .95$, $p = .341$. For the intrinsic motivation variables, interest in games was a significant predictor for enjoyment, $\beta = .15$, $t(267) = 2.41$, $p = .016$; and effort, $\beta = .12$, $t(267) = 2.00$, $p = .047$. Interest in games was not a significant predictor for value, $\beta = .12$, $t(267) = 1.92$, $p = .056$; choice, $\beta = .07$, $t(267) = 1.15$, $p = .250$; or competence, $\beta = .10$, $t(266) = .17$, $p = .085$. Therefore, H_{2b} and H_{2c} were supported; H_{2d} was partially supported.

Interest in deception. H_3 predicted that, for users playing a training game, higher interest in deception detection would predict higher scores on measures of: (a) outcome-focused; (b) process-focused; (c) means-focused; and (d) intrinsic motivation. Results show that interest in deception detection was a significant predictor for outcome-focused motivation, $\beta = .15$, $t(268) = 2.55$, $p = .011$; and process-focused motivation, $\beta = .32$, $t(267) = 5.47$, $p < .001$. However, interest in deception detection was not a significant predictor for means-focused motivation, $\beta = .14$, $t(199) = 1.94$, $p = .054$. For intrinsic motivation, interest in deception detection was a significant predictor for enjoyment, $\beta = .32$, $t(267) = 5.58$, $p < .001$; value, $\beta = .41$, $t(267) = 7.30$, $p < .001$; choice, $\beta = .26$, $t(267) = 4.43$, $p < .001$; and effort, $\beta = .22$, $t(267) = 3.62$, $p < .001$. Interest in deception detection was not a significant predictor for competence $\beta = .08$, $t(266) = 1.35$, $p = .177$. Therefore, H_{3a} and H_{3c} were supported; H_{3d} was partially supported.

Beliefs in games. H_4 predicted that, for users playing a training game, a stronger belief users can learn from digital games will predict higher scores on measures of (a) outcome-focused; (b) process-focused; (c) means-focused; and (d) intrinsic motivation. Results show that beliefs in games was a significant predictor for process-focused motivation, $\beta = .17$, $t(267) = 2.85$, $p = .005$; and means-focused motivation, $\beta = .24$, $t(199) = 3.47$, $p = .001$. Beliefs in games was not a significant predictor for outcome-focused motivation, $\beta = .07$, $t(268) = 1.08$, $p = .281$. For intrinsic motivation, beliefs in games was a significant predictor for enjoyment, $\beta = .19$, $t(267) = 3.19$, $p = .002$; and value, $\beta = .17$, $t(267) = 2.88$, $p = .004$. Beliefs that users can learn from digital games was not a significant predictor for choice, $\beta = .10$, $t(267) = 1.62$, $p = .106$; effort, $\beta = .11$, $t(267) = 1.80$, $p = .073$; or competence, $\beta = .09$, $t(266) = 1.53$, $p = .128$. Therefore, H_{4b} and H_{4c} were supported; H_{4d} was partially supported.

Beliefs in deception. H_5 predicted that, for users playing a training game, a stronger belief users can learn about deception detection will predict higher scores on measures of (a) outcome-focused; (b) process-focused; (c) means-focused; and (d) intrinsic motivation. Results show that beliefs in deception was a significant predictor for process-focused motivation, $\beta = .19$, $t(267) = 3.22$, $p = .001$; and means-focused motivation, $\beta = .17$, $t(199) = 2.42$, $p = .016$. Beliefs in deception was not a significant predictor for outcome-focused motivation, $\beta = .09$, $t(268) = 1.51$, $p = .133$. For intrinsic motivation, beliefs in deception was a significant predictor for enjoyment, $\beta = .26$, $t(267) = 4.45$, $p < .001$; value, $\beta = .32$, $t(267) = 5.57$, $p < .001$; choice, $\beta = .19$, $t(267) = 3.16$, $p = .002$; effort, $\beta = .20$, $t(267) = 3.41$, $p = .001$; and competence, $\beta = .16$, $t(266) = 2.61$, $p = .009$. Therefore, H_{5b}, H_{5c}, and H_{5d} were each supported.

Approach goals. H_6 predicted that, for users playing a training game, stronger approach-oriented goals would predict higher scores on measures of: (a) outcome-focused; (b) process-focused; (c) means-focused; and (d) intrinsic motivation. Results show that stronger approach goals was a significant predictor for process-focused motivation, $\beta = .23$, $t(267) = 3.91$, $p < .001$. Approach goals was not a significant predictor for outcome-focused motivation, $\beta = -.003$, $t(268) = -.04$, $p = .965$; or means-focused motivation, $\beta = .02$, $t(199) = .332$, $p = .74$. For intrinsic motivation, stronger approach orientation goals was a significant predictor for value, $\beta = .13$, $t(267) = 2.22$, $p = .027$. Approach oriented goals was not a significant predictor for enjoyment, $\beta = .09$, $t(267) = 1.42$, $p = .157$; choice, $\beta = .01$, $t(267) = .21$, $p = .832$; effort, $\beta = .01$, $t(267) = .240$, $p = .810$; or competence, $\beta = .03$, $t(266) = .49$, $p = .627$. Therefore, H_{6b} was supported and H_{6d} was partially supported.

Mastery goals. H_7 predicted that, for users playing a training game, stronger mastery-oriented goals would predict higher scores on measures of: (a) outcome-focused; (b) process-focused; (c) means-focused; and (d) intrinsic motivation. Results show that stronger mastery-oriented goals was a significant predictor for process-focused motivation, $\beta = .23$, $t(267) = 3.86$, $p < .001$; and means-focused motivation, $\beta = .17$, $t(199) = 2.44$, $p = .015$. Higher mastery-oriented goals was not a significant predictor for outcome-focused motivation, $\beta = .09$, $t(268) = 1.53$, $p = .128$. For intrinsic motivation, stronger mastery-oriented goals was a significant predictor for enjoyment, $\beta = .14$, $t(267) = 2.29$, $p = .023$; and value, $\beta = .19$, $t(267) = 3.13$, $p = .002$. Stronger mastery oriented goals was not a significant predictor for choice, $\beta = .05$, $t(267) = .81$, $p = .418$; effort, $\beta = .02$, $t(267) = .34$, $p = .731$; or competence, $\beta = .10$, $t(266) = 1.72$, $p = .087$. Therefore, H_{7b} and H_{7c} were supported; H_{7d} was partially supported.

Avoidance goals. H_8 predicted that, for users playing a training game, stronger avoidance-oriented goals would predict lower scores on measures of: (a) outcome-focused; (b) process-focused; (c) means-focused; and (d) intrinsic motivation. Results show that stronger avoidance-oriented goals was a significant predictor for process-focused motivation, $\beta = .22$, $t(267) = 3.67$, $p < .001$; and means-focused motivation, $\beta = .14$, $t(199) = 2.03$, $p = .044$. Stronger avoidance goals was not a significant predictor for outcome-focused motivation, $\beta = .02$, $t(268) = .32$, $p = .752$. For intrinsic motivation, stronger avoidance-oriented goals was a significant predictor for enjoyment, $\beta = .13$, $t(267) = 2.17$, $p = .031$; and value, $\beta = .18$, $t(267) = 2.92$, $p = .004$. Avoidance oriented goals was not a significant predictor for choice, $\beta = .05$, $t(267) = .76$, $p = .45$; effort, $\beta = .04$, $t(267) = .71$, $p = .477$; or competence, $\beta = .008$, $t(266) = .13$, $p = .899$. Although avoidance goals was shown to significantly predict means-focused motivation, process-focused motivation, enjoyment, and value, these results were in the direction opposite of what was hypothesized. Thus, none of the hypotheses for H_8 were supported.

Needs in games. H_9 predicted that, for users playing a training game, a greater indication that needs can be met playing games would predict higher scores on measures of: (a) outcome-focused; (b) process-focused; (c) means-focused; and (d) intrinsic motivation. Results show that needs met in games was a significant predictor for process-focused motivation, $\beta = .13$, $t(267) = 2.18$, $p = .030$; and means-focused motivation, $\beta = .23$, $t(199) = 3.41$, $p = .001$. Needs met in games was not a significant predictor for outcome-focused motivation, $\beta = .03$, $t(268) = .52$, $p = .601$. For intrinsic motivation, needs met from games was not a significant predictor for enjoyment, $\beta = .05$, $t(267) = .86$, $p = .389$; value, $\beta = -.04$, $t(267) = -.59$, $p = .554$; choice, $\beta = .03$, $t(267) = .49$, $p = .626$; effort, $\beta = .07$, $t(267) = 1.23$, p

= .219; or competence, β = .06, $t(266)$ = .98, p = .326. Therefore, H_{9b} and H_{9c} were supported.

Needs in deception. H_{10} predicted that, for users playing a training game, a greater indication that needs can be met learning about deception would predict higher scores on measures of: (a) outcome-focused; (b) process-focused; (c) means-focused; and (d) intrinsic motivation. Results show that needs met in deception was a significant predictor for outcome-focused motivation, β = .14, $t(268)$ = 2.37, p = .019; and process-focused motivation, β = .33, $t(267)$ = 5.67, p < .001. Needs met in deception was not a significant predictor for means-focused motivation, β = .11, $t(199)$ = 1.62, p = .106. For intrinsic motivation, needs met from learning about deception detection was a significant predictor for enjoyment, β = .26, $t(267)$ = 4.47, p < .001; value, β = .36, $t(267)$ = 6.4, p < .001; choice, β = .26, $t(267)$ = 4.40, p < .001; and effort, β = .19, $t(267)$ = 3.15, p = .002. Needs met from deception was not a significant predictor for competence, β = .10, $t(266)$ = 1.60, p = .111. Therefore, H_{10a} and H_{10c} were supported; H_{10d} was partially supported.

Knowledge in games. H_{11} predicted that, for users playing a training game, greater knowledge in digital games would predict higher outcome measures of: (a) outcome-focused; (b) process-focused; (c) means-focused; and (d) intrinsic motivation. Results show that knowledge in games was a significant predictor for process-focused motivation, β = .16, $t(267)$ = 2.72, p = .007. However, knowledge in games was not a significant predictor for outcome-focused motivation, β = .08, $t(268)$ = 1.28, p = .202; or means-focused motivation, β = .13, $t(199)$ = 1.81, p = .071. For intrinsic motivation, greater knowledge in games was a significant predictor for competence, β = .14, $t(266)$ = 2.23, p = .026. Greater knowledge in games was not a significant predictor for enjoyment, β = .10, $t(267)$ = 1.58, p = .115; value,

β = .02, $t(267)$ = .26, p = .795; choice, β = .05, $t(267)$ = .83, p = .407; or effort, β = .10, $t(267)$ = 1.64, p = .102. Therefore, H_{11b} was supported and H_{11d} was partially supported.

Knowledge in deception. H_{12} predicted that, for users playing a training game, greater knowledge in deception detection would predict higher scores on measures of: (a) outcome-focused; (b) process-focused; (c) means-focused; and (d) intrinsic motivation. Results show that knowledge in deception detection was a significant predictor for process-focused motivation, β = .29, $t(267)$ = 5.05, p < .001. Knowledge in deception detection was not a significant predictor for outcome-focused motivation, β = .11, $t(268)$ = 1.79, p = .074; or means-focused motivation, β = .05, $t(199)$ = .67, p = .505. For intrinsic motivation, greater knowledge in detecting deception was a significant predictor for enjoyment, β = .18, $t(267)$ = 3.04, p = .003; value, β = .24, $t(267)$ = 4.09, p < .001; choice, β = .12, $t(267)$ = 1.99, p = .048; and effort, β = .16, $t(267)$ = 2.63, p = .009. Knowledge on deception detection was not a significant predictor for competence β = .08, $t(266)$ = 1.31, p = .192. Therefore, H_{12b} was supported and H_{12d} was partially supported.

Summary of SCF Analysis. In summary of H_2 through H_{12}, Table 7 lists the β regression coefficients and significance levels for each outcome variable. Similarly, Table 9 (at the end of this chapter) summarizes the outcome for each hypothesis test. However, because there may be significant correlations among the variables, the individual variable regressions are not actually independent; that is, some of the variance in the outcomes explained by each separate SCF is possibly shared by other SCFs, so the results thus far are over-estimations of unique variance and significance.

Thus, to identify the unique variance explained by each of the SCFs across all outcomes, a final set of linear regressions was calculated for each outcome with all SCFs forward entered (not stepwise) in the following order: interests in games; interest in deception; beliefs in games; beliefs in deception; approach goals; mastery goals; avoidance goals; needs in games; needs in deception; knowledge in games; and knowledge in deception. A summary of the final regression model examining the unique variance predicted for each outcome by each SCF is shown in Table 8. Although a smaller number of SCFs were significant influencers on the outcome variables in this final model, this analysis represents the most robust predictors for each outcome variable. This is because these regression coefficients remain significant even when their unique variance (rather than shared) is assessed.

For outcome-focused motivation none of the SCFs remained significant predictors in the final model. For process-focused motivation, beliefs in learning deception detection was a significant predictor $\beta = -.22$, $t(268) = -2.12$, $p = .035$. For means-focused motivation, needs met in games was a significant predictor $\beta = .26$, $t(200) = 2.1$, $p = .037$. For enjoyment, interest in learning deception was a significant predictor $\beta = .32$, $t(268) = 2.54$, $p = .012$. For value, both interest in learning deception $\beta = .32$, $t(268) = 2.66$, $p = .008$ and needs met in games $\beta = -.22$, $t(268) = -2.19$, $p = .029$ were both significant predictors. For choice, none of the SCFs remained significant predictors in the final model. For effort, mastery goals was a significant predictor $\beta = -.26$, $t(268) = -2.73$, $p = .007$. For competence, beliefs in learning deception detection was a significant predictor $\beta = .24$, $t(267) = 2.15$, $p = .032$.

Table 6

Legend for Table Labels

Type	**Labels**	Description	Measure
Predictor	**Int. games**	Interest in games	SCF interest in games
Predictor	**Int. decep.**	Interest in deception detection	SCF interest in deception
Predictor	**Bel. Games**	Beliefs in games	SCF beliefs in games
Predictor	**Bel. decep.**	Beliefs in deception detection	SCF beliefs in deception
Predictor	**App. Goals**	Approach goals	SCF approach goals
Predictor	**Mast. Goals**	Mastery goals	SCF mastery goals
Predictor	**Avoid goals**	Avoidance goals	SCF avoidance goals
Predictor	**Need games**	Needs in games	SCF needs in games
Predictor	**Need decep.**	Needs in deception detection	SCF needs in deception
Predictor	**Know games**	Knowledge in games	SCF knowledge in games
Predictor	**Know decep.**	Knowledge in deception	SCF knowledge in deception
Outcome	**OFM**	Outcome-focused motivation	Learning difference scores
Outcome	**PFM**	Process-focused motivation	Activity Motivation
Outcome	**MFM**	Means-focused motivation	In-game questions asked
Outcome	**Enjoy**	Enjoyment	Intrinsic motivation
Outcome	**Value**	Value	Intrinsic motivation
Outcome	**Choice**	Choice	Intrinsic motivation
Outcome	**Effort**	Effort	Intrinsic motivation
Outcome	**Comp.**	Competence	Intrinsic motivation

Table 7

Bivariate Regression Coefficients for SCFs & Motivation

	Posttest Only							
				Intrinsic Motivation				
Explanatory Variables	**OFM**	**PFM**	**MFM**	**Enjoy**	**Value**	**Choice**	**Effort**	**Comp.**
Int. games	.06	.19*	.22*	.15*	.12	.07	.12*	.1
Int. decep.	.15*	.32***	.14	.32***	.41***	.26***	.22***	.08
Bel. games	.07	.17**	.24***	.19**	.17**	.1	.11	.09
Bel. decep.	.09	.19***	.17*	.26***	.32***	.19**	.20***	.16**
App. goals	-.003	.23***	.02	.09	.13*	.01	.01	.03
Mast. goals	.09	.23***	.17*	.14*	.19*	.05	.02	.1
Avoid goals	.02	.22***	.14*	.13*	.17**	.05	.04	.008
Need games	.03	.13*	.23***	.05	-.04	.03	.07	.06
Need decep.	.14**	.33***	.11	.26***	.36***	.26***	.19**	.1
Know games	.08	.16**	.13	.1	.02	.05	.1	.14*
Know decep.	.11	.29***	.05	.18**	.24***	.12*	.16**	.08

* $p < .05$, ** $p < .01$, *** $p < .001$

Table 8

Multiple Regression Coefficients for Final Model

		Posttest Only							
				Intrinsic Motivation					
Explanatory variables	**OFM (Diff)**	**PFM**	**MFM**	**Enjoy**	**Val.**	**Choice**	**Effort**	**Comp.**
Int. games	-.04	.04	.06	-.01	.02	-.02	.14	.1
Int. decep.	.16	.23	.05	.32*	.32*	.21	.09	-.17
Bel. Games	.02	-.04	.1	.17	.18	.06	-.07	-.09
Bel. decep.	-.13	-.22*	.17	.01	-.05	-.01	.19	.24*
App. Goals	-.08	.09	-.18	-.02	.02	-.03	-.03	-.02
Mast. Goals	.09	.02	.01	-.1	-.03	-.14	-.26*	.02
Avoid goals	-.01	.06	.12	.07	.09	.01	.04	-.05
Need games	-.06	-.05	.26 *	-.08	-.22*	.01	.06	-.1
Need decep.	.07	.17	-.06	-.01	.1	.19	.04	.07
Know games	.11	.07	-.14	.04	-.04	.04	.04	.18
Know decep.	.02	.12	-.08	-.03	-.01	-.07	.04	-.02
Adj R^2	-.003	.13	.07	.08	.17	.05	.05	.01
F(11, 258)	.94							
F(11, 189)			2.30 *					
F(11, 257)		4.57 ***		3.25 ***	5.92 ***	2.36*	2.23*	
F(11, 256)								1.28
N	269	268	200	268	268	268	268	267

* $p < .05$, ** $p < .01$, *** $p < .001$

Table 9

Summary of hypotheses results

H	Explanatory variable	Outcomes			
H_1	In comparison to users who watch a PowerPoint training lecture, users who play a digital training game will exhibit:	Greater learning in deception detection knowledge Yes			
	For users playing a training game …	**Outcome-focused**	**Process-focused**	**Means-focused**	**Intrinsic motivation**
H_2	higher interest in learning from digital games will predict higher scores on:	No	Yes	Yes	Partial Support
H_3	higher interest in learning about deception detection will predict higher scores on:	Yes	Yes	No	Partial Support
H_4	a stronger belief users can learn from digital games will predict higher scores on:	No	Yes	Yes	Partial Support
H_5	a stronger belief users can learn about deception detection will predict higher scores on:	No	Yes	Yes	Yes
H_6	stronger approach oriented goals will predict higher scores on:	No	Yes	No	Partial Support
H_7	stronger mastery oriented goals will predict higher scores on:	No	Yes	Yes	Partial Support
H_8	stronger avoidance oriented goals will predict lower scores on:	No	No	No	No
H_9	greater needs met from playing digital games will predict higher scores on:	No	Yes	Yes	No
H_{10}	greater needs met from learning about deception detection will predict higher scores on:	Yes	Yes	No	Partial Support
H_{11}	greater pre-existing knowledge in digital games will predict higher scores on:	No	Yes	No	Partial Support
H_{12}	greater pre-existing knowledge in deception detection will predict higher scores on:	No	Yes	No	Partial Support

VI. General Discussion

The goal of this dissertation was to examine the conditions in which learners are more likely to benefit from DGBL. Rather than manipulating the features of a game to examine the impact on students, the current study examined the students themselves. It was hypothesized that a students' pre-existing perceptions and motivations related to digital games in general and deception detection in particular may predict effectiveness for users in a deception detection training game. This study used a mixed-methods design to explore the impact of five student-centered factors (SCFs; interest, beliefs, goals, needs, and knowledge) on learning and motivation. Study I (Chapter III) used an online survey to test the effectiveness of an instrument designed to measure SCFs, and provide the basis for improving those measures. Study II (Chapter IV) used focus groups and interviews to explore whether SCFs impact user experiences when play-testing a deception detection training game, VERITAS. Study III (Chapter V) used a pretest-posttest experimental design to examine the influence of SCFs on learning and motivation in DGBL.

This dissertation uses an embedded approach to mixed-methods research: the qualitative data were gathered to form an initial impression and played a secondary role to inform the quantitative data. In an embedded design both data types are mixed in the final stage of interpretation to produce insights that could not otherwise be achieved without comparing the data (Creswell & Plano Clark, 2007; Myers, 2014). As such, results from both qualitative and quantitative methods are interpreted concurrently in the following discussion of the theoretical implications; limitations; and future directions for research.

Theoretical Implications

Hypothesis 1 predicted that, in comparison to users who watch a PPT lecture training, users who play a digital training game will exhibit greater levels of learning in deception detection knowledge. This hypothesis was supported as users achieved higher scores in the VERITAS condition in comparison to the PPT condition. Although the differences in scores was statistically significant, an overview of the results shows that the differences were relatively small with only .11 (on a 5-point scale) separating final scores between VERITAS and PPT. This shows that the game-based learning condition only had a weak impact on improving learning overall. This result fits within the context of past meta-analyses, which show that digital games can enhance learning in comparison to traditional teaching methods, but they generally facilitate only minor improvements (Mayer, 2014a; Wouters, van Nimwegen, van Oostendorp, & van der Spek, 2013; Wouters & van Oostendorp, 2017).

Still, game-based training may be more effective in enhancing learning for specific types of users. In the case of learners who reported that their first language was not English, results showed that their scores exhibited a more substantive significant increase in learning with .37 (on a 5-point scale) separating the final scores between VERITAS and PPT. In other words, English as a second language (ESL) learners achieved higher scores in deception detection knowledge after playing VERITAS; in the PowerPoint condition, ESL learners did not perform quite as well. This fits within the context of extant literature that posits that DGBL may be especially effective in teaching students who come from minority and historically disadvantaged groups (Ke & Grabowski, 2007; Rosa, et al., 2003; Squire, 2008).

When considering why minority and historically disadvantaged students may perform better in DGBL, Eveland's (2003) mixed attribute approach to comparing media effects is useful. Using this framework, the following differences between the PPT training and the game-based training are made clear: the PPT lecture training provides a high degree of textuality, a low degree of sensory channel engagement, a low degree of interactivity, a low degree of control, and a low degree of time; VERITAS uses a high degree of textuality, a high degree of sensory channel engagement, a high degree of interactivity, a high degree of control; and a high degree of time. Given these differences, it is likely that the greater levels of sensory engagement, interactivity, control, and practice time afforded in the training game better facilitate learning for ESL students.

Research in this area suggests that learners from minority and historically disadvantaged groups may indeed benefit from particular types of teaching methods. Brophy (1990) explains that:

> Compared to more advantaged students, disadvantaged students will need more explanation of the purposes of activities, more cognitive modeling of the processes involved in responding to them, more extensive scaffolding through shorter steps toward eventual independent and self-regulated performance, and more post-performance guided reflection designed to develop recognition of how the activity fits into the bigger picture, meta cognitive awareness of the strategies involved in accomplishing it, and motivational appreciation of the accomplishment itself as a significant addition to the student's knowledge and skill (p. 173).

Programs that can compensate for the gaps and limitations of more traditional educational environments by providing the types of learning experiences discussed in this quoted recommendation will best help students from minority and historically disadvantaged groups to learn (Brophy, 1990). As such, it is not surprising that the greater sensory engagement, interactivity, control, and practice time provided in VERITAS likely contributes to higher achievement in learning deception detection knowledge for ESL learners. These mechanisms may help disadvantaged students to control the pacing of their learning for their own specific needs and may also facilitate greater motivational appreciation of the learning accomplishment.

Similarly, responses from the focus groups and interviews highlight the fact that students find the game-like features of VERITAS to perform an important function for their learning: participants indicate that the practice opportunities afforded in VERITAS are particularly useful. This fits within the context of Automaticity Theory, which states that learning takes place through a three-step process: (1) the encoding stage; (2) the associative stage; and (3) the autonomous stage (Fitts & Posner, 1967; Singley & Anderson, 1989). As discussed previously, DGBL follows this process and provides opportunities for repeated exposure or practice; this ultimately allows for the recall of content material to become more routine. The game-like features of VERITAS allow ESL students, who may be disadvantaged in working with a language that is not their primary one, to have more practice opportunities to better learn the topic and achieve comparable scores to more advantaged students. In this way, DGBL functions as a learning tool that provides small benefits for advantaged students, but stronger benefits for disadvantaged students. Thus, DGBL facilitates more equitable learning experiences between both disadvantaged and advantaged learners.

Interests. Hypothesis two predicted that, for users playing a training game, higher interest in learning from digital games will predict higher scores on outcome variables. Results show that interest in learning from digital games is positively related to process-focused motivation (activity motivation), means-focused motivation (in-game questions asked), and two intrinsic motivation variables (enjoyment & effort). However, the correlations for each of these relationships is relatively small (.12 to .22). Out of these variables, student interest in digital games most strongly predicts means-focused motivation; indicating that users who are more interested in learning from digital games are more likely to ask additional questions when playing VERITAS. However, the final regression model shows that interest in games is not a significant predictor for the outcome variables in this study when the variance shared by each of the SCFs is removed from analysis. Thus, student interest in games only weakly predicts means-focused motivation.

Hypothesis three predicted that, for users playing a training game, higher interest in learning about the topic of deception detection will predict higher scores on outcome variables. Results show that interest in learning about deception detection is positively related to outcome-focused motivation (learning difference scores), process-focused motivation (activity motivation), and four intrinsic motivation variables (enjoyment, value, choice, & effort). The correlations from these relationships range from small to medium (.15 to .41). Out of these variables, interest in the topic of deception detection has a medium positive relationship with process-outcome motivation, enjoyment, and value. Indeed, the final regression model also shows that interest in deception detection by itself is a significant predictor for both enjoyment and value. This indicates that users who are more interested in learning about the topic of deception detection will likely find the experience more enjoyable and valuable; thus, they are more intrinsically motivated by the process of the learning activity.

Results regarding student interests fit within a pattern of literature, which posits that the greater interest a learner has in a topic, the more motivated they will be to learn (Hidi, 2001; Pintrich, 2003). For interest in learning from digital games, the impacts are small. For interest in learning about the specific topic of deception detection, results are more robust with two medium sized correlations in the final model. This supports other similar research suggesting that, when it comes to serious games, interest towards the topic of learning is generally more important than interest in games themselves (Rodríguez-Aflecht et al., 2016). This is also shown to be the case in the focus groups and interview data;

participants explained that VERITAS did not function like a traditional game. Thus, their interest in games was a nominal consideration and did not play a conscious role in influencing learner experiences in the specific context of a training game like VERITAS.

This suggests an important insight regarding the role of digital games in education. On the one hand, if a DGBL platform does not appear to function as a video game, it is unlikely that a user's prior interest in games will positively or negatively impact their experience in DGBL. In this way, a digital game is likely to be equally effective for students regardless of their pre-existing interest in games. On the other hand, if a DGBL platform does not appear to function as a video game, it may not prime the psychological benefits that are normally associated with digital games. Therefore, further research is needed to explore whether DGBL programs that are more traditionally *gameful* (i.e., featuring more traditional game-like features) may be more strongly influenced by student interests in games in comparison to less gameful DGBL programs.

Beliefs. Hypothesis four predicted that for users playing a training game, a stronger belief that they can learn from digital games will predict higher scores on outcome variables. Results show that a stronger belief in digital games is positively related to process-focused motivation (activity motivation), means-focused motivation (in-game questions), and two variables from intrinsic motivation (enjoyment & value). However, the correlations for each of these relationships are also relatively small (.17 to .24). Out of these variables, stronger beliefs in learning from digital games best predicts means-focused motivation; indicating that users who have a stronger belief that they can learn from digital games are more likely to ask additional questions when playing the digital training game beyond the minimum amount of questions required to play. However, the final regression model shows that beliefs in games is not a significant predictor for the outcome variables in this study when the variance shared by each of the SCFs is removed from analysis. Thus, student beliefs in games only weakly predicts means-focused motivation.

Hypothesis five predicted that, for users playing a training game, a stronger belief that they can learn about the topic of deception detection will predict higher scores on outcome variables. Results show that having a stronger belief that a user can learn deception detection is positively related to process-focused motivation (activity motivation), means-focused motivation (in-game questions asked), and all five variables in intrinsic motivation (enjoyment, value, choice, effort, & competence). The correlations from these relationships range from small to medium (.17 to .32). Out of these variables, beliefs in learning about deception detection, most strongly predicts value. This indicates that users who are more likely to believe that they can learn about deception detection are more likely to value the task.

However, the final regression model shows somewhat conflicting and counter-intuitive findings for beliefs about deception detection. Beliefs about deception detection predict a significant negative relationship for process-focused motivation and a significant positive relationship for competence. This means that when the variance shared by each of the SCFs is removed from analysis, users who are more likely to believe that they can learn to identify deception experience less pleasure in the process of learning by a small degree; but they feel more competent in their ability while learning. This appears to run somewhat counter to past studies, which posit that the more a student believes that they can learn about a topic the more motivated they will be (Schunk, 1989; Schunk & Pajares, 2009).

In reconciling this finding, speculation suggests that a specific feature of training may contribute to this phenomenon: perhaps users who are more likely to believe they can learn deception detection hold this belief because they think that spotting a liar is an easy task; thus, they are more likely to believe that they are capable of learning to do so. Yet, one of the goals of VERITAS is to show users how difficult this task can actually be. By showing users that deception detection is challenging, the goal of the game is to heighten user awareness regarding truth and deception cues so they are less likely to rely on myths and cognitive biases. Therefore, users who think the task is going to be easy may then discover that deception detection is much more challenging than they originally anticipated. This may subsequently require users to exert more cognitive effort than they initially planned. Nonetheless, after learning the material, they feel more competent from playing. These results suggest that beliefs about a learning topic may negatively impact process-focused motivation.

One theory that provides explanatory value to this counter-intuitive finding is *Expectancy Violation Theory* (EVT; Burgoon & Jones, 1976). Although EVT is most often utilized to explain unexpected social behaviors, it can also be applied to other contexts associated with unexpected events. At its core, the theory explains that when an unexpected situation occurs, it may be regarded negatively or positively depending on one's attitude toward the event. If a user expects that a learning task is going to be easy, but subsequently finds the task to be more challenging, it is reasonable that a user may have a negative attitude toward this unexpected event; thus, they are likely to take less pleasure from the task. Still, this outcome does not prevent users from developing a competence in performing the activity.

In this way, results regarding student beliefs fit within the overall pattern of literature, which posits that the beliefs students hold regarding their ability to perform well in school may impact their motivation and subsequent behavior to perform well (Schunk, 1989; Schunk & Pajares, 2009). Although most of the correlations are small, a stronger belief in learning from digital games may relate to means-focused motivation; and a stronger belief in learning about deception detection best predicts competence. Results from the focus groups and interviews show that most participants believe that digital games can function as a teaching tool, but some users believe that other more traditional types of teaching programs are more effective. The findings from the main experiment suggest that believing whether a game can teach or not has relatively little impact on learning overall. Because beliefs in the effectiveness of DGBL do not positively or negative impact learning, this suggests that a digital game is likely to be equally effective for students regardless of their pre-existing beliefs in games. Rather, the topic of learning is more likely to play a stronger role in positively or negative influencing motivation.

Goals. Hypothesis six predicted that, for users playing a training game, stronger approach goals will predict higher outcome scores. Findings show that having a stronger approach-orientation to goals is significantly related to process-focused motivation and one of the variables from intrinsic motivation (value). However, the correlations for each of these relationships is relatively small (.13 & .23). Out of these variables, stronger approach oriented goals most strongly predicts process-focused motivation; indicating that users who have stronger approach oriented goals are more likely motivated by the general process of learning in VERITAS by a small degree. Still, the final regression model shows that having approach oriented goals is not a significant predictor for the outcome variables in this study when the variance shared by each of the SCFs is removed from analysis. Thus, an approach orientation to goals only weakly predicts process-focused motivation.

Hypothesis seven predicted that, for users playing a training game, stronger mastery goals will predict higher outcome scores. Results show that a higher mastery orientation is positively related to process-focused motivation, means-focused motivation, and two variables from intrinsic motivation (enjoyment & value). The correlations for each of these relationships is relatively small (.17 to .22). Out of these variables, a stronger mastery orientation to goals better predicts process-focused motivation; indicating that users who have a stronger mastery orientation are more likely to be motivated in the general process of learning within VERITAS by a small degree.

However, the final regression model for mastery goals again shows somewhat counter-intuitive findings: a stronger mastery orientation to goals significantly negatively predicts effort in VERITAS. This result runs counter to the literature that suggests that students with more mastery oriented goals will be more motivated to achieve (Maehr & Zusho, 2009). Speculation as to why this occurred suggests that perhaps something about the training again may cause students who traditionally follow a mastery orientation approach to their goals to put less effort into VERITAS; or to at least perceive that they put less effort into VERITAS.

This is a phenomenon that may be at least partially explained by *Cognitive Dissonance Theory* (Festinger, 1962). Cognitive dissonance theory explains that when a user has thoughts, behaviors, and outcomes that are not aligned, a user will engage in some type of justification process to bring alignment and create a sense of consonance to otherwise uncomfortable dissonant perceptions. In the case of VERITAS, it is possible that users seeking to master the topic of deception detection may again have been disappointed to learn that detecting a liar is actually a complicated and sometimes fruitless process. The goal of VERITAS is to help users to accept that spotting a liar is challenging, but to give them a research-based set of tools they can draw upon, which is more likely to help them identify deception, but will never be fool-proof. Thus, a user seeking to master the topic of deception detection who is not able to meet their mastery goal may justify their lack of goal attainment by explaining that perhaps they just did not put sufficient effort into the task. This justification may allow users with a mastery goal to cope with the fact that identifying deception may not be an activity they will actually be able to master. This poses interesting implications for deception detection training more broadly and researchers seeking to develop more effective deception detection trainings may need to take additional steps in helping users to manage dissonant thoughts and feelings that might result from training and may negatively impact learning. By allowing users an opportunity to cope with the fact that deception detection is a difficult, but not impossible task, users may feel more comfortable putting effort into a task; or at least perceiving that they are putting effort into a task.

Hypothesis eight predicted that higher avoidance goals will predict lower outcome scores. However, results show that an avoidance orientation is positively related to process-focused motivation, means-focused motivation, and two variables from intrinsic motivation (enjoyment & value). The correlations for each of these relationships are relatively small (.13 to .23). Interestingly, avoidance goals do not produce a negative relationship as predicted. Out of these variables, a stronger avoidance orientation most strongly predicts process-focused motivation; indicating that users who have a stronger avoidance orientation are more likely motivated in the general process of learning by a small degree. However, the final regression model shows that a stronger avoidance orientation to goals is not a significant predictor for the outcome variables in this study when the variance shared by each of the SCFs is removed from analysis. Thus, having an avoidance goal orientation only weakly predicts process-focused motivation.

Overall, findings on student goals ultimately fit with the context of the past literature, which posits that a student's goals may impact their subsequent learning to some degree (Erhel & Jamet, 2013; Maehr & Zusho, 2009). Approach oriented, mastery oriented, and avoidance oriented goals each predict small relationships with the outcome variables. Although an avoidance orientation to goals does not result in any negative relationships, a mastery orientation to goals produces a negative relationship for effort. Further insights from the focus groups and interviews may also help explain these findings. When comparing the experiences from participants in the focus groups and interviews, users express a range of goals that informed their play in VERITAS. They express goals of competition (approach), learning the topic (mastery), following the narrative, and finishing quickly. Although participants express having these goals, they do not express whether their goals in each of these domains is actually satisfied in VERITAS. Perhaps it is not enough to have a mastery orientation approach to goals; but one must actually fulfill this particular goal to feel like they can exert the proper amount of effort in a task.

These results together suggest several insights regarding training in digital games. First, VERITAS as a game does not provide a vehicle for users to meet goals related to competition as there is no social component or ability to share scores. VERITAS may also inadvertently give users the perception that they cannot achieve mastery oriented goals as well due to the difficult nature of the topic. However, because VERITAS lacks a social dynamic, this may actually provide better opportunities for users with an avoidance oriented goal to feel safer learning in this environment. Because there is no competitive dimension, a user who might ordinarily shy away from a social learning task may be more likely to excel in a learning task without a social component. Although having an avoidance orientation to goals only weakly predicts outcomes, these results as a whole suggest that goals in DGBL play a potentially important role in impacting motivation and learning.

Thus, when designing a game for learning, researchers must consider the types of players who will utilize the game and how their goal orientations might interact with the training. Users with approach oriented goals may learn best when a game features a competitive or collaborative mechanism. Users with mastery oriented goals may learn best when the topic material is presented in a way that allows them to attain mastery. Users with avoidance oriented goals may learn best when a game features the ability for solo play. Therefore, an effective DGBL program should seek to accommodate each of these types of users to facilitate the most effective levels of motivation and learning.

Needs. Hypothesis nine predicted that, for users playing a training game, greater needs met from playing digital games will improve outcome scores. Results show that student needs met from games is positively related to process-focused motivation (activity motivation) and means-focused motivation (in-game questions asked). However, the correlations for each of these relationships is relatively small (.23 & .13). Out of these variables, student needs in games most strongly predicts means-focused motivation; indicating that users who could satisfy their needs in digital games are more likely to ask additional questions when playing VERITAS beyond the minimum amount required to play. Similarly, the final regression model also shows this result: when the variance shared by each of the SCFs is removed from analysis, student needs met in games is shown to be the best predictor for means-focused motivation. This suggests that users who report that their needs can be satisfied from playing digital games are more likely to engage appropriately in a DGBL tool such as VERITAS by asking more questions.

Appropriate engagement in the DGBL program refers to any type of behavior that is more likely to promote learning. As explained by Touré-Tillery and Fishbach (2014) behavioral measures are used to examine a person’s observable actions during the process of completing a goal and the degree to which the action matches the most appropriate type of behavior for the task. For example, if a learner is required to answer at least 5 out of 10 questions, but the learner answers all 10 questions, this indicates higher motivation (process-focused motivation; means-focused motivation).

However, it is important to mention that assumptions associated with behavioral measures must appropriately consider the context of the behavior. For example, in some contexts, perhaps asking too many questions is likely to be inappropriate because it may indicate that a learner is not paying attention or is simply going too slowly. However, insight from the focus group participants tells us that users who seek to finish the game quickly are actually engaging in the most inappropriate behaviors and are more likely to miss important parts of the training program; similarly, they receive less opportunities to practice their deception detection knowledge.

Inversely, participants who ask more questions are spending more time in the game, are not rushing through the learning experience, and are engaging in more deception detection practice. These behaviors exemplify more appropriate learning strategies. Thus, the more questions a student asks and the more time they invest in the game, the more this behavior is considered appropriately suited to aid their learning in a game like VERITAS. This fits within the pattern of previous literature, which posits that when users are able to satisfy important needs, they will be more likely to be motivated (Ryan & Deci, 2000). Therefore, it can be argued that because there is a positive relationship between needs met in games and in-game questions asked, that these users are more motivated to use appropriate methods during the learning process in DGBL (means-focused motivation).

However, the final regression model also shows somewhat conflicting and counter-intuitive findings for needs satisfied in digital games. Although needs satisfied in digital games predicts a significant positive relationship for means-focused motivation, it shows a significant negative relationship for value. This indicates that the more people report they that their needs can be satisfied through games, the less they value the experience playing VERITAS. Observations from the focus groups and interviews provide insight on this counter-intuitive finding. The focus groups and interviews show that VERITAS does not appear to be a typical game. Because VERITAS lacks the entertainment features of an entertainment game and it does not subsequently fit users' mental models of what they normally consider to be a video game, users do not conceptualize this game in the same vein as a standard entertainment game.

This represents an issue when it comes to how users are likely to value the experience of DGBL. If a training game does not function in the same way that entertainment games do, users may not be motivated to play them even though they are ordinarily motivated by entertainment games. This is likely compounded for users who strongly report that their needs are typically met from playing video games. If users report that games typically satisfy their needs, but through the experience of playing VERITAS they discover that it does not satisfy their needs because it is not like most other games they have played, it is reasonable to expect that they might not value the DGBL experience. In reconciling these findings, although having greater needs met from video games may encourage students to engage more with the questions in VERITAS (means-focused motivation), by the end of the experience they realize that VERITAS does not function like a standard game and their needs are not actually satisfied; thus, they feel like the experience is not as valuable.

This poses an important theoretical contribution for researchers. Just because a training program is considered a gamified experience does not necessarily mean that users who ordinarily meet their needs through games will be able to meet their needs in the same way during a learning game. Therefore, a good learning game likely needs to strike a balance between features of a typical video games (extraneous content) and essential content to help users learn effectively (Mayer, 2014a). A game more balanced in this way will likely help students to satisfy their needs from DGBL and perhaps find learning games motivating.

Hypothesis ten predicted that, for users playing a training game, greater needs met from learning about deception detection will improve outcome scores. Results show that needs met from learning about deception detection is significantly related to outcome-focused motivation (learning difference scores), process-focused motivation (activity motivation), and four intrinsic motivation variables (enjoyment, value, choice, & effort). The correlations from these relationships range from small to medium (.14 to .36). Out of these variables, needs met from games more strongly predicts value and process-focused motivation. However, the final regression model shows that needs met from deception detection is not a significant predictor for the outcome variables in this study when the variance shared by each of the SCFs is removed from analysis. Thus, needs satisfied from learning deception detection only weakly predicts value and process-focused motivation.

Knowledge. Hypothesis eleven predicted that, for users playing a training game, greater knowledge in digital games will predict higher outcomes. Results show that greater knowledge is positively related to process-focused motivation (activity motivation) and one of the intrinsic motivation measures (competence). The correlation for each relationship is small (.16 & .14). Out of these variables, greater knowledge in games most strongly predicts process-focused motivation; indicating that users who have more knowledge about games are more likely motivated in the general process of learning by a small degree. However, the final regression model shows that knowledge in games is not a significant predictor for the outcome variables in this study when the variance shared by each of the SCFs is removed from analysis. Thus, knowledge in games only weakly predicts process-focused motivation.

Hypothesis twelve predicted that, for users playing a training game, greater knowledge in the topic of deception detection will predict higher outcomes. Results showed that greater knowledge about deception detection is positively related to process-focused motivation (activity motivation), and four variables in intrinsic motivation (enjoyment, value, choice, & effort). These correlations are mostly small (.12 to .29). Out of these variables, knowledge on deception detection most strongly predicts process-focused motivation; indicating that users who believe they have more knowledge on deception detection are more likely to be motivated in the learning process. However, the final regression model again shows that knowledge in deception detection is not a significant predictor for the outcome variables in this study when the variance shared by each of the SCFs is removed from analysis. Thus, knowledge in deception detection only weakly predicts process-focused motivation.

Taken together, student prior knowledge in video games and deception detection does not strongly predict any of the motivation dimensions. Still, past literature suggests that learners with a solid foundation or strong existing schemata are more likely to build upon their existing knowledge to produce greater understandings (Bartlett, 1932; Sweller, 2005). Although it is assumed that students who perceive that they have a high degree of knowledge are expected to indicate higher motivation, this is not the case in the context of VERITAS. From examining the focus groups and interview data, participants report that perceiving knowledge on deception detection actually creates the opposite effect and may induce a sense of overconfidence at the beginning of a training experience and this overconfidence may not be particularly useful.

In this way, perhaps prior knowledge on a topic may not always be useful if the prior knowledge is not accurate. For example, many users believe inaccurate deception detection stereotypes: as reported previously, research shows that liars and truth-tellers do not actually differ in their eye gaze behaviors (Mann et al., 2012); however, a cross-cultural examination of attitudes about deception from 58 different countries indicates that 64% of people inaccurately believe a lack of eye contact is a reliable deception cue (The Global Deception Research Team, 2006). However, although inaccurate knowledge may not help learning, it appears that prior knowledge in general (both in games and the topic of deception) only played a weak role to impact motivation in this study.

Summary. The following five key findings represent the strongest outcomes of this research: First, levels of learning are shown to be significantly higher in the context of the game-based training in comparison to the PPT lecture-based training; this is especially the case for ESL students. In this way, DGBL may function as a learning tool that provides small benefits for advantaged students, but stronger benefits for disadvantaged students. Thus, DGBL enables the opportunity for more equitable learning experiences between both disadvantaged and advantaged learners. Second, interest in the topic of deception detection is the best predictor for the intrinsic motivation variables of enjoyment and value; this suggests that the topic of learning may be more motivating than features of DGBL itself.

Third, having a stronger belief in one's own ability to learn about the topic of deception detection produces counter-intuitive results. Having a stronger belief that one can learn about deception detection is negatively related to process-focused motivation and positively related to competence. Speculation suggests that users who realize a task is more challenging than expected may not find the experience as pleasurable as previously anticipated. Nonetheless, they experience a sense of competence from the learning task.

Fourth, mastery goals also produce a counter intuitive finding: a stronger mastery orientation negatively predicts effort in VERITAS. Speculation in this vein suggests that if a user typically follows a mastery goal orientation, but mastery of the specific topic cannot be achieved, users may be likely to justify feelings of dissonance by reporting less effort exerted in the task. Lastly, users who report that their needs are satisfied in digital games are more likely to engage appropriately in a DGBL task, however if they are not actually able to satisfy their needs, they are not likely to value the experience. Overall, insights suggest that student interests, beliefs, goals, needs, and prior knowledge produce both interesting and complicated results that require further investigation within each domain.

Limitations and Directions for Future Research

Three primary limitations of this study are discussed. The first limitation refers to the measures of the SCFs. Although a pilot study was used to generate a valid instrument for participants to self-report their interests, beliefs, goals, needs, and knowledge, due to limitations of time and space within the broader NSF funded project, the final SCF measure was kept short to avoid participant fatigue. This instrumentation may benefit from even further revision to better improve the validity and robustness for each of the subscales. For example, the majority of the subscales were only composed of 3 questions: this may not be enough items to adequately quantify a person's experience within each SCF. In addition, two of the subscales produced a less than ideal level of reliability (avoidance oriented goals, and knowledge about deception detection). However, these measures were still maintained to begin making progress in exploring these factors. Therefore, future iterations of instrument development for SCFs should pursue adding additional items and continue to refine the measure to best develop a way for students to self-report their prior interests, beliefs, goals, needs and knowledge in relation to games and learning.

The second limitation refers to an issue of external validity that impacts interpretation of findings in this study. Results from this research indicate that VERITAS outperforms a PPT training to a small degree in improving knowledge of deception detection scores as measured by difference scores between a pre- and posttest test of recall. However, it is unknown whether knowledge in more research-based deception detection cues will result in transferable skills in deception detection that can be enacted beyond the context of the laboratory experiment. A skills test was designed for this study to assess whether skills could be transferred to identify deception in videos of real-world truth-tellers and deceivers. However, this skills test was not an effective measure; thus, no skills assessment was available for participants in this study. Although the predictions in this study only examined learning in terms of knowledge recall, readers should not equate the knowledge results with subsequent real-world skills in deception detection.

This limitation is also related to the larger issue identified previously in the literature on DGBL: the problem of transfer (Bellotti, Kapralos, Lee, Moreno-Ger, & Berta, 2013; Shaffer, 2012). In DGBL, the goal is to teach students how to take knowledge acquired in a game and allow that knowledge to transfer to everyday knowledge and skills (Shaffer, 2012). Although participants in the game-based learning platform improved by a small degree in their deception detection within the game, this may not translate to real-life skills. Recommendations on training effectiveness in the area of deception detection advise that training must be extensive, accurate, and relevant to real world scenarios (Frank & Feeley, 2003; Vrij, 2008). Though the game-based program may have been extensive and accurate, perhaps the domain of a video game may not be the most relevant field to learn transferable skills. As such, more research is needed in the form of longitudinal field studies to examine the ways training games may impact credibility assessment.

The third limitation refers to an issue of the training stimuli itself. This study sought to examine the role of SCFs in DGBL experiences. However, the focus group and interview results suggest that VERITAS may not be perceived as a "game." It does not trigger a learner's mental model for what they ordinarily consider to be a game-like experience. Therefore, lacking game-like features, it may not have triggered the ways in which students ordinarily interact with learning games that possess more gameful qualities. Thus, it is not surprising that the SCFs related to past experiences in games are likely to play a weaker role in a game that functions more like a training, such as VERITAS.

This brings up an important implication in DGBL research. Video games can be defined in a variety of ways (Juul, 2005). One definition explains that video games are inviting and accumulative simulations that feature interactivity, rules, responsiveness, and challenges (Mayer & Johnson, 2010). Under this definition, VERITAS could be described as a video game. However, Upchurch and Wildermuth (2014) explain that 14 different features of games can enhance teaching and learning practices: (1) chance; (2) control; (3) creativity; (4) completion; (5) spectacle; (6) status; (7) strategy; (8) unification; (9) rules; (10) narrative; (11) recognition; (12) collaboration; (13) escapism; and (14) enjoyment. Under this model of what makes a good game, VERITAS is likely lacking in the majority of these areas; this may be why VERITAS is not considered to be a game according to students. Therefore, this may have dulled the results as student who are highly interested in playing games may not show the same level of interest in a training simulation as opposed to a more true to form training game.

If VERITAS is not perceived to be a "game" by users, the motivational benefits that might ordinarily encourage users to play entertainment games may not function properly in the context of a learning simulation game such as this one. Questions can be posed in this vein: Does a game need to be perceived as such to be motivating? What features of games promote greater levels of motivation and how can we best tap into these features for educational purposes? A training game that is better able to tap into the benefits of video games while still retaining educational qualities will be more useful in assessing the impact of student-centered factors in future research on DGBL.

Concluding Remarks

As teaching and learning tools become more technologically advanced, scholars will continue to explore the ways that digital technologies impact education. From a new media perspective, this research explores the affordances and limitations of DGBL. Rather than manipulating the features of a game to examine the impact on students, the current study examined the students themselves. Early scholars in the field of DGBL praised games for their potential to impact teaching and learning processes; however, the data from this dissertation suggest that this one-size-fits all approach to DGBL may not effectively improve educational spaces for all learners. Users are likely to interact with a learning tool based on their own unique prior experiences. Their interests, beliefs, goals, needs, and knowledge may play a role in their ability to learn in a game-based training. By seeking to understand the relationship between SCFs, learning, and motivation, scholars can better design games to serve diverse students in our evolving digital age.

"Would we not prefer an approach…that exploits the pedagogical promise of emerging interactive technologies, meets students' expectations for deep digital engagement, motivates persistence, customizes the experience to each student's unique needs, and promotes both long-term memory and the transfer of learning to the practical realm of everyday life? This is the promise of digital game based learning"

– Foreman (2003, p. 14)

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Appendices

Appendix A: Student-Centered Factors (Pilot Test)

The following scale concerns your experience with a variety of topics including video games, learning, and the topic of deception detection. Please respond by indicating to what extent you agree with each statement (1-7 strongly disagree to strongly agree).

Student Interests

Game Subscale

1. I'm interested in learning new information from playing a video game.
2. I find the idea of learning from a video game to be intriguing.

Deception Subscale

3. I'm interested in learning more about the topic of deception detection.
4. Learning deception detection skills is likely to be a valuable experience for me.

Student Beliefs

Game Subscale

1. I believe I can learn something useful from a video game.
2. I think that I am capable of learning from a video game.

Deception Subscale

3. I believe there is more information I could learn about the topic of deception detection.
4. I believe I'm capable of learning to tell the difference between truths and lies.

Student Goals

Game Approach Subscale

1. My goal when playing a video game is to perform well so others will know how capable I am.

Game Avoid Subscale

2. My goal when playing a video game is to try not to perform badly.

Gamer Mastery Subscale

3. My goal when playing a video game is to perform well so I will know that I have mastered the game.

Deception Approach Subscale

4. My goal when learning a new topic is to show others how capable I am.

Deception Avoid Subscale

5. My goal when learning something new is to try not to perform badly.

Deception Mastery Subscale

6. My goal when learning new information is to master the topic so I know that I am skilled in the subject.

Student Needs

Game Subscale

1. When I play a video game, I feel like I'm able to satisfy some of my own personal needs.
2. I find video games rewarding to play on a personal level.

Deception Subscale

3. Learning about a topic like deception detection allows me to satisfy some of my own personal needs.
4. I find the idea of learning more about deception detection personally rewarding.

Student Prior Knowledge

Game Subscale

1. Based on my previous video game knowledge, I feel prepared to learn how to play a new video game.
2. Because of my prior video game play experience, I understand how video games all basically work.

Deception Subscale

3. Based on my previous knowledge about deception, I feel prepared to learn more about deception detection.
4. I already have a good foundation of knowledge on the topic of deception detection.

Appendix B: Student-Centered Factors (Main Experiment)

The following scale concerns your experience with a variety of topics including video games, learning, and the topic of deception detection. Please respond by indicating to what extent you agree with each statement (1-7 strongly disagree to strongly agree).

Student Interests

Game Subscale

1. I'm interested in learning new information from playing a video game.
2. I find the idea of learning from a video game to be intriguing.
3. Because I'm interested in playing video games, I'm also interested in using video games as a learning tool

Deception Subscale

1. I'm interested in learning more about the topic of deception detection.
2. Learning deception detection is an intriguing subject area to me.
3. Because I'm interested in the topic of deception detection, I'm also interested in learning more about this subject area.

Student Beliefs

Game Subscale

1. I believe I can learn something useful from a video game.
2. I think that I am capable of learning from a video game.
3. I believe that I can learn real world knowledge and skills form playing video games.

Deception Subscale

1. I believe there is more information I could learn about the topic of deception detection.
2. I believe I could learn how to better tell the difference between truths and lies.
3. I believe that I can learn deception detection skills through training on the topic.

Student Goals

Approach Subscale

1. My goal when playing a video game is to perform well so others will know how capable I am.
2. If I do well when playing a video game, I'm glad because others may find out.
3. My goal when learning a new topic is to show others how capable I am.
4. If I do well when learning about a topic like deception detection, I would be glad because others may find out.

Avoid Subscale

1. My goal when playing a video game is to try not to perform badly.
2. If I do poorly when playing a video game, I’m worried because others may find out.
3. My goal when learning something new is to try not to perform badly.
4. If I do poorly when learning about a topic like deception detection, I would be worried because others may find out.

Mastery Subscale

1. My goal when playing a video game is usually to perform well so I will know that I have mastered the game.
2. If I do well when playing a video game, I’m glad simply because I know I have performed well.
3. My goal when learning new information is to master the topic so I know that I am skilled in the subject.
4. If I do well when learning about a topic like deception detection, I would be glad simply because I know I have performed well.

Student Needs

Game Subscale

1. When I play a video game, I feel like I’m able to satisfy some of my own personal needs.
2. I find video games rewarding to play on a personal level.
3. I feel like my experience when playing video games is usually fulfilling.

Deception Subscale

1. Learning about a topic like deception detection could allow me to satisfy a personal need.
2. I think the process of learning more about deception detection would be personally rewarding.
3. I think learning about deception detection could be a fulfilling experience.

Student Prior Knowledge

Game Subscale

1. Based on my previous video game knowledge, I feel prepared to learn how to play a new video game.
2. Because of my prior video game play experience, I generally understand how video games all basically work.
3. If I were to start a new video game, I could probably figure out the controls quickly.

Deception Subscale

1. Based on my previous knowledge about deception, I feel prepared to learn more about deception detection.
2. I know enough about the basics of detecting deception, so I could continue building on my foundation of knowledge in that area.
3. If I were to start learning more about deception detection, I could probably pick it up quickly.

Appendix C: Focus Group and Interview Questions

Welcome, and thank you for attending the VERITAS playtest. My name is [Aubrie Adams] and I will be moderating our session. I will primarily ask you questions about your past experiences with video games and your experiences with VERITAS.

We have [#] participants today. [Say each individual's first name]. I will ask the group questions and I encourage you to give your honest answers, even if others disagree. Feel free to offer praise or criticism. This feedback will identify the parts of the game that worked well for you and the parts that did not work well so we can improve the game. I did not create VERITAS, so you will not hurt my feelings if you have suggestions for improvement. The game team welcomes your honesty.

I have many questions for you, so I ask you to please keep your answers brief. I will keep things moving and will make sure everyone contributes. I may even call on some of you by name to ask you to comment on certain questions. If we report any results of this focus group, no participant will be identified by name.

Any questions? Let's begin!

[Ask participants to indicate whether they agree with specific statements, in a "show of hands" throughout]

General Evaluation of Veritas

1. What did you like/dislike about Veritas?
2. If you were designing this game, what would you do differently?
3. Did anyone access the supplemental documents?

Student Interests

1. How do you define video games?
2. How often do you play video games?
3. How did your interest in playing video games impact your experience playing Veritas?

Student Beliefs

1. What beliefs do you have about learning from video games?
2. What impact did your beliefs about learning from games have on your experience of playing Veritas?

Student Goals

1. When you were playing the game, what were your primary goals?
2. How do you think your goals impacted your experience of playing Veritas?

Student Needs

1. What are the primary reasons you play video games?

2. How did your reasons for playing video games impact your experience playing Veritas?

Student Prior Knowledge
1. When you first started, did you think you could figure out how to play the game?
2. How did your knowledge of playing video games impact your experience of playing Veritas?
3. When you first started, how good did you think you were at detecting deception?
4. What impact did your prior knowledge about deception have on your experience of playing Veritas?

Additional Questions
1. What motivated you to do well in the game?
2. How fun was the game (on a scale of 1-10)?
3. Added – anything else?

CIRCLING BACK

[Paraphrase some of the themes that emerged and see if the group still agrees, has additional insights. Confirm with them whether they still feel strongly about some of the specific praise or criticism they expressed earlier.]

GROUP INFLUENCE

Now that you have heard comments from others in the group, have you changed your thinking about anything in any way? How has the group influenced your opinions?

ANYTHING ELSE?

Do you have any other stories, comments, praise, criticism, or suggestions for us?

THANK YOU

Your participation has been tremendously helpful. Thank you for taking the time to talk with me today.
[Tell them how they will receive their incentive for participation]

Appendix D: Codebook: Emergent Themes

Student Interests

1. Absent game mechanics (42)

Definition: A theme that represents comments describing a game-based training as lacking in traditional video game mechanics.
Indicators: When a comment describes a game-based training as unlike a video game and more like a training simulation.
Exclusions: Does not include examples of game-mechanics being present.
Example: *I felt like it wasn't really a video game, so it's hard for me to compare. It was more of a learning simulation module.*

2. Helpful game mechanics (24)

Definition: A theme representing comments that describe how game-like mechanics may enhance learning.
Indicators: When a comment describes the ways that any type of game-like mechanic featured in the training provided a useful function in learning. It may work to benefit proxies of learning such as enhancing engagement, identifying patterns, or motivating higher achievement.
Exclusions: Does not include examples in which a training does not have gaming mechanisms.
Example: *I can definitely see the game mechanics being used and that did help me with the system a bit.*

Student Beliefs

3. Games help learning (47)

Definition: A theme that represents comments describing how video games have the potential to effectively teach in either overt or unintentional ways.
Indicators: When a comment acknowledges that a person can learn something useful from video games.
Exclusions: Does not include examples in which video games are described as ineffective in helping people learn.
Example: *Games that are specifically intended to teach stuff, like whatever the game we just played, I think those you can definitely learn from.*

4. Games do not help learning (22)

Definition: A theme that represents comments describing how video games are not effective in teaching real-world knowledge or skills.
Indicators: When a comment explains that games should only be used for entertainment or they do not benefit learners in any substantial way.
Exclusions: Does not include examples in which games are shown to be useful for teaching and learning.
Example: *I also feel like videogames make it too concentrated on the videogames that you don't always know how to apply it in your life.*

Student Goals

5. Competition (40)

Definition: A theme that represents comments describing goals that include doing better either for interpersonal intrapersonal oriented reasons.
Indicators: When a comment explains that a person wants to simply perform better in the game, receiving a high score, do better than others, or win.
Exclusions: Does not include examples in which they are referring to actually learning the content; instead, they just want to perform well.
Example: *My goal is just to not have that stupid little red x at the end.*

6. Topic learning (27)

Definition: A theme that represents comments describing goals that include learning the content material and being interested in the material.
Indicators: When a comment explains that a person is trying to learn the actually content the game is designed to teach. It's about focusing and paying attention to learn the content and showing interest for the subject matter.
Exclusions: Does not include examples in which they are trying to do better simple to perform better.
Example: *I think my goal was just to learn about deception because it is a useful thing to know about.*

7. Narrative enjoyment (9)

Definition: A theme that represents comments describing goals that include enjoying the narrative.
Indicators: When a comment explains that a person's goal is to find out more about what is happening in the story. The fictional story is shown to be motivating or interesting.
Exclusions: Does not include examples in which a person's goal is to learn the content.
Example: *I wanted to really figure out who was the villain in the end.*

8. Hurried finish (11)

Definition: A theme that represents comments describing goals that include accomplishing the task of finishing.
Indicators: When a comment explains that a person just wanted to get through the training program as quickly as possible. It's about being done, not learning a skill or gaining anything.
Exclusions: Does not include examples in which a person benefits from the experience other than simply finishing.
Example: *I mean, I feel like I didn't see it as a game, I was just trying to finish it.*

Student Needs

9. Entertainment seeking (20)

Definition: A theme that represents comments describing needs that include actively seeking entertainment

Indicators: When a comment explains that a person is seeking some form of entertainment like seeking excitement, fun, engagement, addiction. Includes some relieve of boredom, but is more about active entertainment.
Exclusions: Does not include examples implying a release from stress or escaping.
Example: *Sometimes I want something more engaging. It's actually kinda hard for me to just sit down and watch a movie, you know, because it's kinda boring and it's not very engaging.*

10. Escapism (13)

Definition: A theme that represents comments describing needs that include relieving stress, unwinding, or disconnecting from reality in some way.
Indicators: When a comment explains that a person is seeking some form of relaxation or disconnecting from the real-world. May be about trying to pass the time and reduce boredom; implies a passive form of getting away from it all.
Exclusions: Does not include examples implying they are being entertained in some way.
Example: *Just to destress, that kind of thing. Like when I'm at school, usually I only play videogames when I'm at home, so it's just to relax a little bit*

11. Socialize (15)

Definition: A theme that represents comments describing needs that include relating to the social benefits of games.
Indicators: When a comment explains that a person's goal is to connect socially with others, bond in a game or hang out.
Exclusions: Does not include examples in which a person's goal is to be competitive or beat their friends while being social.
Example: *I use it to stay in touch with my friends…because it's challenging and its fun and it's immersive it gives us something to do and it allows us to have fun and kinda facilitates that.*

12. Lacking entertainment (7)

Definition: A theme that represents comments describing how a game-based training was lacking in entertaining qualities such as fun; because this is an important need, the lack of entertainment detracted from the learning experience.
Indicators: When a comment explains that a participant plays game to satisfy entertainment needs, but the game didn't satisfy this need.
Exclusions: Does not include examples in which needs were satisfied.
Example: *Yeah, I said I would play a game to enjoy it, but I don't know if I would say that VERITAS was enjoyable. Because it wasn't like something fun.*

Student Knowledge

13. Intuitive design (35)

Definition: A theme that represents comments describing how a game based learning program was easy to play.
Indicators: When a comment explains that most anyone could play the game because it was intuitive and easy.

Exclusions: Does not include examples in which someone imagined how someone might not find the game easy to play.
Example: *I feel like you don't have to be experienced with games to be honest. It's kind of logical. Like click, click, next. That's about it.*

14. Hypothetical challenges (6)

Definition: A theme that represents comments describing how there is a potential that someone might struggle with a game-based learning program.
Indicators: When a comment explains that there is an imagined situation when someone might not be able to understand how to play the game.
Exclusions: Does not include examples in which are not hypotheticals.
Example: *Um, so my parents, no cell phone ever, like ever. And just they don't really see themselves as people who want to or need to, for the lack of better words, get on board, or kind of use technology in the way that most people do, they're quite the opposite. So, they would probably definitely shy away from something like Veritas.*

15. Overconfidence (21)

Definition: A theme that represents comments describing how someone's overconfidence played a role in impacting their learning
Indicators: When a comment explains that they were confident about their knowledge on a topic, but learned that this confidence was unjustified. Can be used to showcase both positive and negative implications.
Exclusions: Does not include examples in which a person was not confident in their original content skills.
Example: *I also think I was a little overconfident in some answers because of my prior beliefs…. For like certain things like the nervousness and stuff. But after I got one wrong I just realized that's definitely not what we're looking for.*

Appendix E: Deception Detection Knowledge Test

Pretest

The following questions will test your knowledge of deception detection. Please answer using the options below each question.

1. Spontaneous corrections happen when a speaker corrects his/her own mistakes while talking. They are used more by truth-tellers than deceivers.
   A. True*
   B. False

2. When someone embraces their story and really "owns" it, it is called ______ and is associated with truth-telling more than deceiving.
   A. Plausibility
   B. Logical structure
   C. Certainty*
   D. Verifiable detail

3. Truth-tellers are more confident in their story than liars and so that results in using greater ______ than deceivers.
   A. Smiling and relaxation*
   B. Vagueness
   C. Negative words
   D. Eye gaze

4. When someone is lying, they tend to avoid eye gaze with the interviewer because they feel guilty about lying.
   A. True
   B. False*

5. Telling a story that you make up is more difficult than recalling a story from your memory. This results in greater ______ for deceivers compared to truth-tellers because they have to think harder
   A. Vagueness
   B. Relaxation
   C. Cognitive load*
   D. Spontaneous corrections

6. There are three basic patterns of deceivers that can be used to detect deception. These may be manifested in different ways by different deceivers but most cues fit into one of these three categories. They include all of the following EXCEPT:
   A. Tension
   B. Uncertainty
   C. Cognitive load
   D. Nervousness*

7. Liars play with their hands and fidget in their seats more than truth-tellers.
   A. True
   B. False*

8. One of the best ways to detect deception is not to focus on the behavior of the liar but to check the facts. Use evidence and check to see if a liar's story is logically consistent with what they have said before.
   A. True*
   B. False

9. The term "immediacy" refers to involvement or enthusiasm when talking and is shown more by:
   A. Deceivers
   B. Truth-tellers*

One sign of the "cognitive overload" experienced by deceivers is that, compared to people who are telling the truth, they:
   A. Repeat the same language more often*
   B. Avoid eye gaze more
   C. Shift their body posture more
   D. Tell more detailed stories

Posttest

The following questions will test your knowledge of deception detection. Please answer using the options below each question.

1. What are spontaneous corrections?
   A. Someone catches you lying and fact-checks you on the spot
   B. A speaker corrects his/her own mistakes while talking*
   C. A speaker includes details in their statements that can be verified
   D. None of these options

2. When someone embraces their story and really "owns" it, it is called CERTAINTY. Is associated with truth-telling or deceiving?
   A. Truth-telling*
   B. Deceiving

3. Truth-tellers are more confident in their story than liars and so that results in greater smiling and relaxation than deceivers.
   A. True*
   B. False

4. Which of the following is the best example of a reliable deception cue?
   A. Avoiding eye gaze
   B. Fidgeting and looking nervous
   C. Sweating

D. Thinking hard while answering*

5. Telling a story that you make up is more difficult than recalling a story from your memory. When you have to think hard, it is because lying causes more than telling the truth.

A. Vagueness
B. Relaxation
C. Cognitive load*
D. Spontaneous corrections

6. There are three basic patterns of deceivers that can be used to detect deception. These may be manifested in different ways by different deceivers but most cues fit into one of these three categories. The three patterns are: tension, uncertainty, and cognitive load.

A. True*
B. False

7. Liars look more "shifty" than truth-tellers. They move around in their seat and play with their hands.

A. True
B. False*

8. If you check a person's facts to see if what they are saying matches up with what they have said before, you are _______ using to detect deception.

A. Logical consistency*
B. Spontaneous correction
C. Behavioral observation
D. Plausible deniabiltiy

9. The term "immediacy" refers to involvement or enthusiasm when talking and is shown more by deceivers than truth-tellers because they want to appear honest.

A. True*
B. False

10. Repeating the same language often is a sign of _______ the experienced by deceivers.

A. Cognitive load*
B. Tension
C. Emotional load
D. Guilt

*Indicates a correct response

Appendix F: Activity Motivation (Process-focused motivation)

Using the scale below, please indicate to what extent each of the following items corresponds to one of the reasons for which you are presently practicing this deception detection training activity (1-7 does not correspond at all to correspond exactly)

1. For the pleasure I feel in the experience. **(Stimulation)**
2. For the pleasure it gives me to know more about my abilities at detecting deception. **(Knowledge)**
3. For the pleasure of discovering new training techniques. **(Knowledge)**
4. Because I feel a lot of personal satisfaction while mastering certain difficult training techniques. **(Accomplishment)**
5. For the excitement I feel when I am really involved in the activity. **(Stimulation)**
6. For the satisfaction I experience while I am perfecting my abilities. **(Accomplishment)**
7. Because it is a good way to learn lots of things which could be useful to me in other areas of my life. **(Knowledge)**
8. For the positive way I feel while I'm successfully detecting deception. **(Accomplishment)**
9. For the pleasure I feel while demonstrating certain difficult aspects of deception detection. **(Accomplishment)**
10. Because I like the feeling of being totally immersed in the activity. **(Stimulation)**
11. As much for engaging in this activity itself as for the eventual payoff should I get good at deception detection. **(Accomplishment)**

Appendix G: Intrinsic Motivation

Think about the training on deception detection you participated in. For each of the following statements, please indicate how true it is for you, using the following scale: 1 = Strongly Disagree, 7 = Strongly Agree

Enjoyment

1. I enjoyed doing this activity very much
2. This activity was fun to do
3. I thought this was a boring activity*
4. This activity did not hold my attention at all*
5. I would describe this activity as very interesting
6. I thought this activity was quite enjoyable
7. While I was doing this activity, I was thinking about how much I enjoyed it

Competence

1. I think I am pretty good at this activity
2. I think I did pretty well at this activity, compared to others
3. I am satisfied with my performance at this task
4. I was pretty skilled at this activity

Effort

1. I put a lot of effort into this
2. I didn’t try very hard to do well at this activity*
3. I tried very hard on this activity
4. I didn’t put much energy into this*

Choice

1. I felt like it was not my own choice to do this task*
2. I felt like I had to do this*
3. I did this activity because I had no choice*
4. I did this activity because I wanted to
5. I did this activity because I had to*

Value

1. I believe this activity could be of some value to me
2. I think this is important to do because it can help me detect deception
3. I believe doing this activity could be beneficial to me
4. I think this is an important activity

*Indicates a reverse-coded item