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Applying Basic Gamification Techniques to IT Compliance Training: Evidence from the Lab and Field

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ABSTRACT: Companies depend on internal control to protect the integrity of information systems. IT security and data privacy training are critical controls for safeguarding company information. Employees often dislike the training, however, which can cause a lack of attention to, and poor understanding of, training concepts leading to less effective internal control. To improve the training experience, companies are implementing principles of games in employee training modules, a practice known as gamification. Utilizing a laboratory experiment on data privacy training and a field study involving IT security training for employees of a bank, we test whether a training environment with basic gamification elements results in greater trainee satisfaction and knowledge acquisition than traditional, non-gamified training. We find basic gamification results in higher satisfaction levels in the lab and field, but only marginally significant improvements in learning. Furthermore, these learning improvements are quite small (e.g., 1 to 3 percent). Finally, we find that "gamers" (i.e., those who participate in gaming on their own time) gain more knowledge from gamified training than "non-gamers," although gamers are less satisfied with gamified training.

Keywords: gamification; information security; data privacy; compliance training.

Data Availability: Please contact the authors.

I. INTRODUCTION

A firm's internal control effectiveness depends, in part, upon individual competence, awareness, and compliance. "The strength of any internal control system is largely a function of the people who operate it. In other words, no matter how sound the control processes may be, they will fail unless the personnel who apply them are competent and honest" (Gelinas, Dull, and Wheeler 2011, 230). Internal control guidance emphasizes the importance of policies and procedures (COSO 2013). Lack of compliance with policies by personnel at any level can short circuit a well-designed management control system. The implementation of a security awareness program is an important component for an internal controls system because "security awareness is a key link in an organization's security chain, as even the most efficient security mechanisms have little value in an organization with no security culture" (Rantos, Fysarakis, and Manifavas 2012, 328).

While firms traditionally rely on training programs to increase awareness of risks and controls, "compliance training is considered a necessary evil for most organizations" (Donovan 2012, 15), and firms find it difficult to hold "a trainee's attention

We thank True Office for facilitating access to research participants and providing the training materials we use. We note that although True Office helped provide access to some research participants, we had control over the development of testing instruments. This paper has greatly benefited from the helpful suggestions of A. Faye Borthick (editor) and two anonymous reviewers. We also thank Rick Dull, Amy Igou, Mark Metcalf, Garrison Nuttall, Greg Richens, and participants at the 2015 AIS Midyear Meeting for providing helpful comments and suggestions.

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sufficiently long to impart a message . . . particularly when the training is mandated and the target audience views the topic as potentially mundane" (Cone, Irvine, Thompson, and Nguyen 2007, 64 [referring to information security]). A recent practice survey of over 3,000 employees found that only 32 percent "agreed or strongly agreed that the compliance training they received over the past year was engaging" (Quaranta 2013, ¶6). "Most training sessions are just too dull . . . People aren't even completing these things, they're so boring" (Totty 2005, ¶4–5).

Ineffective training can have detrimental effects on internal controls, and thus impact financial and managerial accounting as well as tax reporting. For example, following the passage of the Sarbanes-Oxley Act, training issues were frequently cited as material weaknesses of the control environment in audits of internal control over financial reporting (Klamm and Watson 2009).[1] In order to make training more effective, there is a growing trend among companies to "use the design principles behind games to try to make the affective experience of work more positive and fun for their employees," a practice known as "gamification" (Mollick and Rothbard 2014, 3). In this study, we investigate the effects of very basic, introductory gamification techniques on training by conducting a laboratory experiment comparing the effectiveness of various types of training and a field study of over 850 employees participating in gamified information security training as part of their professional responsibilities.

Studying the effects of gamification, even basic gamification, on training satisfaction and learning is an important endeavor for accounting research for several reasons. As mentioned, training is a critical internal control and an important part of managing risk in organizations (COSO 2013). Furthermore, accountants are required to participate in a significant amount of annual training to maintain professional certifications in nearly all areas of accounting (e.g., CPA, CIA, CISA, CMA). Also, security concepts and training are an important component taught as part of the accounting information systems curriculum (e.g., Romney and Steinbart 2015). Thus, understanding ways to improve training has the potential to improve many aspects of accounting.

IT compliance training presents a particularly relevant and interesting domain for study because IT issues evolve rapidly and may lead to pervasive internal control threats. Ironically, while professional accountants and auditors view IT training as a general control with the potential to influence a firm's many practices and processes, individual employees generally perceive IT security and data privacy as less threatening than more tangible health and personal safety compliance issues (e.g., fire safety) (Karjalainen and Siponen 2011). In the last few years, however, it has become clear "that companies should no longer ask if they are going to be hacked and instead when" (Chambers and Stewart 2015, ¶1). Thus, to improve internal control in general and IT security specifically, companies must ensure that training programs achieve high completion rates and deep engagement to internalize the knowledge.

Gamification principles may be ideally suited to help improve some or all of these aspects of training. Gamification is the implementation of gaming mechanics to increase engagement with learning content such as the use of stories and themes for role playing, tracking points and earning achievements to demonstrate clear feedback and progress, and the use of competitive tools such as leaderboards to stimulate competition. In this study, we investigate a basic element of gamification, that of using an interactive story-based approach to contextualize the delivery of security and privacy training information. We recognize that there are many other gaming techniques that can be employed and should continue to be studied. This minimalist approach to gamification reflects current practitioner approaches to maximizing the benefits of gamification while minimizing costs.[2]

For this study, we worked with True Office, which incorporates basic elements of gamification into various training modules, to employ a laboratory experiment with student subjects to compare and contrast three conditions: (1) True Office's gamified approach to training, (2) a non-gamified, digitized training developed by Thomson Reuters (which used the same underlying content as True Office), and (3) a control group that received no training.[3] These conditions allow us to test whether training is associated with learning (comparison against no training condition) and whether it is superior to another, non-gamified training approach (comparison against Thomson Reuters's condition).[4]

The results of our experiment suggest that participants find the gamified approach to be more enjoyable, fun, informative, and less boring than the computerized, non-gamified approach. We also find that both the gamified and non-gamified approaches improved learning relative to those that received no training (i.e., control group). Contrary to our expectations

[1] In a study of 490 firms with material weaknesses reported under Sarbanes-Oxley Section 404 during the first year of compliance, Klamm and Watson (2009, 12) report that 50.8 percent of control environment-related material control weaknesses involved "personnel, ethical, or training issues."

[2] The specific training gamification we study employs some basic elements of gamification and not all of the gamification elements that have been developed. Thus, we test a minimal form of gamification. Although minimal, this type of gamification is important to study because it is advertised by developers as a gamified approach to training and is widely used by practitioners. Also, because "full-blown" gamification can be very costly to develop (Donovan 2012), it is valuable to determine the effects of basic, less-costly gamification approaches that may end up being more widely adopted.

[3] True Office entered a partnership to gamify training with Thomson Reuters as reported in early 2013 (McCallion 2013). In late 2014, True Office was acquired by the New York Stock Exchange Governance Services Division (Groenfeldt 2014).

[4] For the purposes of this study, we examine knowledge acquisition and retention as measures of learning.

however, we find evidence that participants receiving the Thomson Reuters computerized, non-gamified training performed slightly better than those receiving gamified training (Thomson Reuters's participants scored 3.1 percent higher than True Office participants). We also tested prior researcher conjectures that individuals with more gaming experience will have greater satisfaction and learning from a gamified approach (Barata, Gama, Jorge, and Gonçalves 2014). Within the gamified training condition, we find that "gamers" (i.e., those participating frequently in gaming on their own time) manifest higher performance on knowledge tests than "non-gamers," although gamers were less satisfied than "non-gamers" with the gamified training. This result suggests that the gamified training may have underwhelmed those that frequently interact with games, but supports the idea that they are able to leverage their gaming fluency to gain more knowledge, albeit modest increases in knowledge, through the gamified format.

To test whether the laboratory results exist in a real-world situation, we worked with True Office to assess the deployment of an information security training program at a large, international bank. Using this field study for data collection, we find strong support that participants enjoy gamified training more than other training modalities they had previously experienced (e.g., in person and PowerPoint with voiceover). We also find marginally statistically significant evidence of improvements in knowledge acquisition, although the economic magnitudes were modest (e.g., test score improvements of 1 percent).

This study makes several contributions to the literature and highlights additional research to be conducted. We contribute to extant gamification literature by conducting the first study examining the effectiveness of elements of gamification within the domain of accounting internal controls, specifically IT compliance education and training. Prior studies have been relatively optimistic about the increased learning potential of gamified training, yet research has shown mixed results. Some research indicates modest or no gains in learning (e.g., college chemistry: Daubenfeld and Zenker 2014; basic IT: Domínguez et al. 2013), while other studies have shown substantial increases in learning performance and knowledge transfer (computer-aided design: Li, Grossman, and Fitzmaurice 2014). Our results indicate that basic gamification modestly improves learning relative to no training, but does not outperform learning relative to other types of training. We do find strong preferences for the gamified approach, which, given the relatively similar performance of the two types of training, suggests that employees will be more satisfied in the short term. We propose that future work consider various longitudinal implications of gamification, such as whether gamification's effects on short-term satisfaction will influence learning in settings where employees are required to participate in frequent training regimens to maintain greater awareness of dynamic threats.

We also contribute to prior literature by studying and demonstrating that individuals' gaming propensity affects satisfaction and learning from gamified training modules. From a practical perspective, our results provide valuable insight to companies using or considering the use of gamified training. Specifically, our results suggest that the benefits of gamification may be more pronounced for companies that are primarily concerned with improving employee engagement during training sessions or for companies whose employees play games on their own time. This is a growing practice area and we hope this study serves to stimulate more research attention to guide its development.

II. LITERATURE REVIEW AND HYPOTHESES

Participation in gaming is increasing and is recognized as a widespread cultural phenomenon (Entertainment Software Association [ESA] 2014). According to the Entertainment Software Association, 59 percent of Americans play video games, and total consumer spending in the computer game industry for 2013 topped $21 billion (ESA 2014). With the widespread familiarity of digital gaming and its obvious intention to entertain, it should come as no surprise that gaming developments and principles are becoming incorporated into other pursuits where an improvement in entertainment might lead to improved engagement.

When games are deployed for reasons other than mere entertainment, they are called "serious games" (Susi, Johanesson, and Backlund 2007).[5] Serious games have existed since ancient times in the form of war games (Halter 2006). Gamification is the adaptation of gaming techniques and mechanics to non-game applications (e.g., education). As found in the serious games literature (Breuer and Bente 2010), the emerging discourse on the use and effectiveness of gamification by both researchers and practitioners is widespread and diverse. For practitioners, the following definition captures the straightforward meaning of gamification:

> Gamification is a business tool that uses computer game elements in non-game situations. Companies that value sales and customer service have already seen success with this approach, as encouragement and motivation are presented by a points and rewards system, adding competition and fun to a role that otherwise could be fairly thankless and disengaging. (Gardiner 2014, ¶2)

[5] The definition of a serious game is not straightforward in the literature. Breuer and Bente (2010) compare the variety and overlap of definitions among serious games, e-learning, game-based learning, entertainment education, etc.

Gamification has been of great interest to educators looking to motivate and engage students (Domínguez et al. 2013). Nascent research continues to expand the constructs and theoretical development surrounding gamification, as evidenced in recent reviews of the subject (e.g., Connolly, E. Boyle, MacArthur, Hainey, and J. Boyle 2012; Wouters, van Nimwegen, van Oostendorp, and van der Spek 2013; Hamari, Koivisto, and Sarsa 2014). Because gamification is an adaptation of techniques, there can be varying degrees of how it can be implemented. In attempting to minimize the amount of resources, some may employ a minimal approach to implementing a few gaming techniques, while other instances may be approaching a fully developed gaming environment. Given that the resource intensity of game development is cited as one of the barriers to implementing these types of training and educational systems (Donovan 2012), we anticipate developers will seek out effective types of gaming mechanics to improve performance over non-gamified training and education.

Gamification and Enjoyment

One of the core purposes of gamification is to use design principles from games to make work a more positive and fun experience (Mollick and Rothbard 2014). This is particularly relevant in the context of IT compliance training, which is often described as dull and boring. Cone et al. (2007, 64) state that for user security awareness training, "holding a trainee's attention sufficiently long to impart a message is a considerable challenge, particularly when the training is mandated and the target audience views the topic as potentially mundane." Nagarajan, Allbeck, Sood, and Janssen (2012, 257) state that traditional security training can "end up overwhelming people and not getting the intended point across. These sessions cannot afford to be boring; they must be involving and fun." Thus, gamification may be ideally suited to improve learning by increasing enjoyment in a dull, boring setting.

Gamification can lead to enjoyment in several different ways. For example, gamification can activate a basic hedonistic value directed toward enjoyment and pleasure. Enjoyment is considered a primary affect or basic emotion (Tomkins 1962) and can be thought of as "a sense of satisfaction and reward generated from the activity and/or the outcome of the activity" (Ainley and Hidi 2014, 206). van der Heijden (2004, 701) found that people are more likely to use a system if it causes enjoyment (i.e., directed toward enjoyment and pleasure) and "that the hedonic value can play a pivotal role to increase acceptance of otherwise utilitarian information systems . . . This is much like a parent persuading a child to swallow a bitter pill by administering it with a sweetener to make it go down more easily." Koivisto and Hamari (2014) found that gamification increases playfulness and fun, both hedonistic mechanisms associated with enjoyment.

We expect that the application of rudimentary gamification into IT compliance training will result in greater enjoyment that non-gamified training, and that the use of such gamification is particularly well suited to IT compliance training because it is often considered dull and boring. Accordingly, we propose our first hypothesis:

H1: Individuals will find gamified compliance training to be more enjoyable than other training types.

Gamification and Learning

While the principles of gamification are expected to make training more enjoyable and fun, they are applied with "the intention to be more than entertainment" (Ritterfield, Cody, and Vorderer 2009, 6). The ultimate goal of gamification in training is to increase learning.

Connolly et al. (2012) suggest that gamification can improve learning by overcoming barriers to learning such as a lack of attention, engagement, and interest. One way gamification overcomes these barriers to learning is by increasing the enjoyment of the task. Prior research reviews suggest that enjoyment is an important factor that directly contributes to improvements in learning (Pekrun, Goetz, Frenzel, Barchfeld, and Perry 2011; Pekrun, Goetz, Titz, and Perry 2002; Pekrun and Linnenbrink-Garcia 2012). For example, M. Ainley and J. Ainley (2011a, 2011b) find that enjoyment is an important predictor of future engagement and learning in the sciences.

An additional hedonic mechanism that gamification may activate is interest because of novelty (Berlyne 1970; Novak 2014).[6] In speaking of online computer simulations similar to gamification, Novak (2014, 78) reports that "the novelty of the learning environment, the variety of visual stimuli and information can hook students' attention and increase the interest toward learning." She finds that student interest and curiosity were the most important factors predicting satisfaction. Thus, to the extent gamification increases students' interest or curiosity, it should also increase their enjoyment with the training.

Finally, gamification can improve learning outcomes through the use of realistic, virtual simulations that are more difficult to achieve in traditional education settings (Deterding, Dixon, Khaled, and Nacke 2011; Reeves and Read 2009). For example,

[6] Berlyne (1970) notes that novelty is a basic affective emotion that increases hedonic value. Novelty may impact learning by more than just enjoyment, as neuropsychologists have also found a positive influence of novelty on memory (e.g., Tulving and Kroll 1995; van Kesteren et al. 2012).

traditional education settings may provide stories or examples in order to describe a challenging concept. Gamified training takes learning one step further by providing learners with the opportunity to actively take part in stories or examples through the use of gaming principles (Hamari et al. 2014), which may increase the realism and subsequent application of the training.

Although gamification has potential for improving learning and is advocated by many (Mayo 2007; Squire 2003; Virvou, Katsionis, and Manos 2005), scientific evidence validating the benefits of gamification on learning is mixed. Connolly et al. (2012) analyzed 129 papers about gaming and found 49 dealt with using games for learning, with the majority of those being simulation games (n = 30). In analyzing a subset of high-quality papers, Connolly et al. (2012, 671) report that "evidence that games lead to more effective learning was not strong." Wouters et al. (2013) report meta-analytic results that serious games were more effective in terms of learning and retention. Devers and Gurung (2015), however, provide a more nuanced discussion of the results of Wouters et al. (2013), noting the following:

> At first glance, the meta-analysis from Wouters et al. (2013) suggests that games are successful and can produce results that outperform "conventional" methods of instruction. However, looking more closely at the data, they also concluded that when experimental studies used random assignment there was not a significant difference between the control and the gaming group (Willingham 2013). Additionally, games did not show any advantage over "passive instruction," which is described as reading a book or a lecture (arguably the most common form of instruction). Interestingly they also found that games were not more motivating, which is often seen as an advantage over other types of instruction. Thus, when experimental design is used, there does not seem to be an advantage for games. (Devers and Gurung 2015, 420–421)

Hamari et al. (2014) echo these concerns in an additional review of gamified literature and note that gamification appears to have some positive effects, but these results are based mostly on qualitative and descriptive studies and the literature lacks strong quantitative studies demonstrating the value of gamification.

These mixed findings do not indicate a clear pattern of learning advantage or disadvantage for gamified education. Given the mixed results, it is likely that greater contextual detail within the studies will continue to reveal the boundary conditions of learning outcomes, both negative and positive. As we argued in motivating H1, gamification should improve enjoyment with the material. As IT compliance training is often viewed as boring, the IT compliance training setting offers an opportunity for gamification to show higher performance by improving enjoyment, and consequently learning. Given this possibility, we make the following directional prediction:

H2: Individuals receiving gamified training will exhibit greater knowledge acquisition than individuals receiving non-gamified training or no training.

The Effect of Gaming Experience on Individual Response to Gamified Training

While gamification is generally regarded as a positive step to engaging individuals, it has also been noted that gamification has the potential to be polarizing in that "the same aspects [viewed positively by some] were most often disliked by some respondents in the study" (Hamari et al. 2014, 4). "Some people like Monopoly, others like World of Warcraft, and some people would really just prefer to quietly read a book in the corner" (Downes-Le Guin, Baker, Mechling, and Ruylea 2012, 631). This line of thinking leads us to consider how the gaming experience or interest in gaming will influence the effect of gamified training on enjoyment and learning.

There are reasons why gamification may both increase and decrease training enjoyment for gamers. An individual that does not regularly use games may be put off by any gaming mechanics employed by gamified training. For example, non-gamers may think games are a waste of time because of how long they take (or other reasons). In contrast, those who do not regularly use games (e.g., because they are too busy) may believe that games are novel and exciting and therefore be more interested in training that uses gamified approaches.

As another example of the possible conflicting effects of prior gaming experience, an individual may have significant gaming experience, and may consequently have very high expectations regarding any type of gaming experience. For gamers, a gamified training session may lack the complexity, richness, and challenge that they have come to anticipate in typical gaming experiences, and may result in low engagement. In contrast, gamers may appreciate training that uses similar gaming mechanics that they choose to enjoy in their spare time, even if the mechanisms are "watered-down" from their prior experience.

Given the polarizing potential of gaming in general (i.e., features can be interpreted at extremes: liked versus disliked) and the contrasting reasons for anticipating both gains and losses due to greater/lesser gaming experience, we do not propose a directional hypothesis between gaming experience and individuals' enjoyment of gamified training. Instead, we examine the following research question:

RQ1: What is the influence of gaming experience on satisfaction from gamified compliance training?

Extant literature has begun to explore the idea of connecting an individual's gaming preferences to learning outcomes. For example, it is possible that increased gaming experience provides an improved ability to attend to information conveyed through gamification. It may be that those with significant gaming experience possess a gaming schema[7] that allows them to better process and remember information when gamification techniques are employed (van Kesteren, Ruiter, Fernández, and Henson 2012). Miller and Robertson (2011) did not, however, find support that previous experience using the same type of gaming environment at home had an effect on learning performance. Thus, it is unclear whether gaming experience will lead to improved learning outcomes in a gamified environment.

As mentioned previously, enjoyment is an important precursor of learning (Pekrun et al. 2011; Pekrun et al. 2002; Pekrun and Linnenbrink-Garcia 2012; Ainley and Ainley 2011a, 2011b), as is novelty (Berlyne 1970; Novak 2014). Thus, to the extent that individuals enjoy gamified training, they are likely to learn more in a gamified training environment. But because gaming is often polarizing, we are unable to hypothesize how those with more/less gaming experience will enjoy the gaming experience. Thus, the impact of gaming experience on learning in a gamified training environment is unclear. Consequently, we refrain from making a directional hypothesis regarding how gaming experience affects the effect of gamified training on learning outcomes. Instead, we pose the following research question:

RQ2: What is the influence of gaming experience on learning from gamified compliance training?

III. EXPERIMENT AND FIELD STUDY SETUPS

To test our hypotheses and research questions, we use a commercially developed gamified training experience from True Office. Although True Office does not provide a complete gamified environment, their training environment employs various elements of games including the use of a story, goals for the employee, feedback, and progress. More specifically, True Office features a story of a fictional investigation of a breach of security that may have compromised an international bank's customer data. Learning objectives are presented in the beginning of the training, and participants complete various milestones before taking a post-training quiz. Milestones include interviewing three persons, identifying and analyzing objects and statements from the three persons, and affirming that the participant has read three policy documents. The visual and audio components use realistic cartoon images and animations that represent people, offices, and typical objects found within such offices. The training uses role playing with the learner in the role of an investigator interviewing people, evaluating objects in the office environment, and making assessments of the fictional employee's statements and the objects. The training uses audio and closed captioning of the audio so that learners can read along while they listen.

Of all of the gaming techniques employed, the True Office environment most strongly leverages the story-based mechanic, supported by a visual and audio environment. Although True Office represents some mechanics of gamification, we note that it lacks other gamification techniques such as competition based on points and leaderboards, achievement badges or levels, or virtual currencies. Even so, the True Office environment is a real-world implementation of gamification that provides a test of one form of gamification on learning.

In order to test our hypotheses, we provide two alternatives—another non-gamified learning experience and a control condition with no training whatsoever. The non-gamified learning experience we chose was a learning module developed by Thomson Reuters. This learning module covered the same topic but did not provide the story-based approach. Using these two conditions allows for a strong test of knowledge acquisition. Specifically, we are able to test whether gamification improves learning relative to no training (whether it is successful in teaching at all) and relative to other training types. This provides a more complete picture of the impact of gamification on knowledge acquisition.

Experimental Setup

To examine our hypotheses, we used a controlled laboratory experiment to compare the game-style approach of True Office training with training provided by Thomson Reuters, described above, and a condition with no training. Both the True Office and Thomson Reuters training modules provided information about data privacy, and the informational content provided by the modules was largely identical.[8] We utilized a 1×3 between-participant design wherein participants were randomly assigned to receive True Office training, Thomson Reuters training, or no training.[9] Those in the no training group took a web-

[7] "Schemas are abstractions from specific instances that can be used to make inferences about instances of the concepts they represent" (Anderson 2005, 158).

[8] The True Office training module used the same underlying content as the Thomson Reuters module. We were unable to identify meaningful practical differences in the content between the types of training. The training did differ in subtle ways such as presentation order of some items, how things were worded and, as indicated above, True Office training used a narrative, gamified format.

[9] Randomization appeared to be successful as there were no significant differences between conditions in terms of gender, age, major, or GPA (all p-values > 0.10). The average GPA was a 3.52 with a standard deviation of 0.58.

based survey, while those in the training groups completed the survey after completing their respective training module. The experiment took approximately 30 minutes to complete.

Participants in the laboratory experiment were students at a large, private university located in the western United States. We invited students to participate for extra credit from an experimental pool of subjects made up of the entire business school. Students self-selected to participate, but were randomly assigned to conditions once they decided to participate. Thirty-three participants were in the True Office condition, 38 participants were in the Thomson Reuters condition, and 45 students were in the No Training condition.[10] The experimental surveys asked questions related to demographics, satisfaction with the training, and knowledge of the training content.

Lab Experiment Assessment Questions

We assessed satisfaction by asking participants in the True Office and Thomson Reuters conditions to rate their respective trainings on several dimensions, including the extent to which they agreed that the training was enjoyable, interesting, boring, fun, informative, and a waste of time. Responses were measured on a seven-point scale (1 = Strongly Disagree; 7 = Strongly Agree).

To measure knowledge of data privacy, participants in all three conditions were asked a series of 44 questions. Knowledge questions were generated by the authors and based on information that could be found both in the True Office and Thomson Reuters training. After completing the knowledge test, we asked a number of questions aimed at assessing participants' attitudes toward data privacy, as well as their opinions as to whether they had the knowledge and skills necessary to address data privacy concerns. Responses to these items were based on a seven-point scale (1 = Strongly Disagree; 7 = Strongly Agree).

As part of the demographic questions, we asked participants questions about their gaming habits. Specifically, we asked participants to provide a self-assessment of whether they were a gamer, how frequently they currently play games, and how much time they spent playing games in the past. We then did a median split to create a dichotomous variable for each variable. Analysis did not reveal any significant correlation between learning outcomes and self-identification as a gamer or past experience playing games. We did find effects, however, based on the median split of current gaming habits. The results presented below are based on a median split, but we advise that the results should be interpreted cautiously as they vary based on how gaming experience is measured.

Field Study Setup

For the field study, we gathered data from one of True Office's clients, a large multinational bank. The bank is publicly traded on the NASDAQ and has more than 3,000 employees. True Office was contracted to provide training for the bank, and the bank agreed to participate in data collection during regularly scheduled training on information security.[11] To facilitate data collection, the bank sent an email to its employees providing a link to one of two web-based surveys. The first survey was administered to a group of employees *before* they had completed the True Office training. These employees responded to the demographic and knowledge questions (discussed subsequently). The second survey was administered to a group of employees *after* completing the True Office training.[12] This survey contained three parts. First, we asked employees demographic questions. Next, we asked questions to test H1 regarding their satisfaction with the True Office training, and their perception of how it compared to other training they had completed in the past. Finally, we asked knowledge questions to test H2 and gauge how well the employees knew the bank's policies regarding information security.[13] A total of 856 bank employees completed the survey. Employees had an average of 10.2 years of experience.[14] Five hundred thirty-one employees completed the survey after receiving True Office training, and 325 employees completed the survey before receiving True Office training.[15]

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[10] Differences in sample size were caused by one row of computers in the computer lab not being able to access the training websites during one of the lab sessions. Thus, we allocated extra participants to the No Training condition during that session.

[11] We chose different, although related, training modules for the field study and experimental portions of this study. The use of different modules provides some evidence that our findings are a result of the game-style approach used by True Office and are not specific to a particular module.

[12] Participants were able to participate in both the pre- and post-surveys (we were unable to restrict or monitor participation in the pre- and post-surveys); we view it as likely, however, that many did, given that there were more than 3,000 employees eligible to participate. The email to the before group was sent to a subset of employees decided by the bank. They said it was a smaller, representative sample of employees. The "after survey" was sent to all employees who completed the training. This does introduce potential validity concerns, which are addressed by the design of our controlled laboratory experiment.

[13] We did not ask questions about gaming experience. The bank wanted the survey to be brief and did not believe these questions were important for their consideration of using the True Office training.

[14] While we had complete control over deciding what knowledge and satisfaction questions to ask, the bank did request that we not ask questions about gender or age to help preserve the anonymity of respondents.

[15] While we solicited participants from multiple countries (after translating the instrument into their native language), we only report the results of responses from U.S. respondents. We did not have sufficient numbers of respondents from other countries to perform meaningful analysis (i.e., we did not have any people from other countries taking the pre-survey). Given different cultures and the possibility of different levels of understanding of the translated materials, we deemed it more appropriate to analyze only responses from U.S. employees.

Field Study Assessment Questions

For employees taking the survey after completing True Office training, the survey included several questions to assess satisfaction with True Office's gamification approach. First, it asked employees to respond to a series of statements related to their satisfaction with the training as it pertained to helping them perform their jobs and understanding their responsibilities (specific wording can be found in Table 1). Responses were based on a seven-point scale (1 = Strongly Disagree; 7 = Strongly Agree).

In order to understand employee satisfaction with True Office's gamified approach to training relative to other training they had received in the past, we asked employees who took the survey after completing True Office training to "compare the most recently completed training by True Office that used an interactive, game-style approach to [their] last training experience that did not use this approach." Employees were to rate which training was better on each of the following six dimensions: enjoyable, interesting, boring, fun, informative, and waste of time. Responses were measured on a seven-point scale (1 = True Office training; 7 = Previous non-True Office training). Our final satisfaction questions asked employees to rank various training modalities (True Office online training using an interactive game-style approach to other types of training, including online training using mostly written materials with voiceover, online training containing only written material, in-person training with a traditional lecture approach, and other) based on which they would prefer for future training.

Surveys for both groups of employees included the same 33 knowledge questions. These questions were generated by the authors to assess employees' grasp of the bank's information security policies and to provide a measure of the knowledge gained as a result of True Office training. Questions were intentionally designed to be difficult by requiring participants to remember specific details of the policies, procedures, and training material.[16]

IV. RESULTS

Experiment Results

Results testing H1 are presented in Table 1, Panel A. Participants in the True Office condition rated their training as more enjoyable, more fun, and less boring than did participants in the Thomson Reuters condition ($p < 0.01$), which supports H1. But, participants in the True Office condition reported their training to be less informative than participants in the Thomson Reuters condition ($p < 0.01$), which speaks indirectly to H2 in that participants did not believe they learned as much in the gamified training condition. There were no significant differences between conditions for the "Interesting" or "Waste of Time" dimensions (p-values > 0.10). On the whole, we interpret the data to suggest that, consistent with H1, participants view gamified training to be more enjoyable than non-gamified training.

Panel B of Table 1 presents tests of H2 by examining the percentage of knowledge questions answered correctly by condition. First, we compare the gamified training to no training to test whether gamification results in any improvement in knowledge. Participants in the True Office condition answered an average of 52.1 percent (S.D. = 7.1 percent) questions correctly, which was significantly better than participants in the No Training condition (mean = 46.0 percent, S.D. = 9.6 percent; $p < 0.01$). In examining the effect size, we note that the gamified training (True Office) resulted in an improvement of 6.1 percent relative to the No Training condition. Given the overall performance of only 46 percent in the No Training condition, this is a sizable 13 percent improvement in performance. In our interpretation, this suggests that relative to no training, gamification results in substantial improvements in knowledge. Overall, the data support H2 in that gamification results in gains in knowledge acquisition relative to no training.

The stronger and more interesting test of knowledge acquisition is the comparison between gamified training and non-gamified training. Participants in the Thomson Reuters condition answered an average of 55.2 percent (S.D. = 5.3 percent) questions correctly, which was marginally significantly better than the True Office training ($p < 0.10$), and significantly better than the No Training ($p < 0.01$) condition. This result does not support H2. Although the result was marginally statistically significant, we note that the improvement in performance was 3.1 percentage points—a modest improvement in terms of economic significance.

In addition to testing knowledge acquisition, we asked participants various other questions about their training experience. We report these results in Table 1, Panel C. Overall, there was little difference in comparing the two types of training. The one

[16] We note that the scores appear to be quite low (hovering around 50 percent correct). The True Office training had its own questions assessing learning. Participants scored around 90 percent on those assessments. We do not report these results, as we did not use any of these questions in the pre-training respondent group; thus, there is no comparison that we can make. We chose not to use them in the pre-training respondent group because many of the questions were context-specific to the True Office training.

TABLE 1

Experimental Results

Comparison of Satisfaction and Knowledge Acquisition with Gamification Training Relative to Alternative Conditions

Panel A: Comparisons of Training Types: Mean (Std.)

Variable	(1) True Office	(2) Thomson Reuters	t-test
Enjoyable	5.36	4.42	3.18***
	(1.14)	(1.33)	
Interesting	5.36	5.26	0.39
	(1.08)	(1.06)	
Boring	2.88	3.58	−2.12**
	(1.39)	(1.39)	
Fun	5.06	4.16	3.02***
	(1.20)	(1.31)	
Informative	5.79	6.34	−2.73***
	(1.05)	(0.53)	
Waste of Time	2.55	2.42	0.47
	(1.28)	(0.89)	

Panel B: Differences in Performance: Mean (Std.)

Condition	(1) True Office	(2) Thomson Reuters	(3) No Training	(1) vs. (2)	(1) vs. (3)	(2) vs. (3)
Exam (Percentage Correctly Listed)	52.1%	55.2%	46.0%	−1.68*	3.51***	5.47***
	(7.1%)	(5.3%)	(9.6%)			

Panel C: Additional Comparisons of Training Types: Mean (Std.)

Question	True Office	Thomson Reuters	t-stat
The privacy of my data as stored and used by companies concerns me.	5.61	4.95	1.93*
	(1.32)	(1.47)	
I am confident that businesses can reasonably keep my personal data confidential.	4.79	4.61	0.54
	(1.54)	(1.44)	
I am concerned about how companies that I interact with take care of my personal data.	5.88	5.55	1.17
	(0.78)	(1.35)	
Data privacy violations seem to happen frequently.	5.39	5.13	0.87
	(1.34)	(1.04)	
Data privacy violations seem to be increasing.	5.73	5.47	0.96
	(1.21)	(1.06)	
I learned new information about data privacy and security by participating in this study.	6.30	6.37	−0.29
	(0.81)	(0.75)	
I understand my responsibilities for protecting information.	5.70	5.95	−1.09
	(0.95)	(0.7)	
I can apply the risk management techniques used in protecting information.	5.42	5.37	0.20
	(1.17)	(1.17)	
I know the reputational importance of effective information security and the consequences of information being lost or stolen.	6.21	6.00	1.08
	(0.70)	(0.77)	

***, **, * Indicate a significant p-value at $p < 0.01$, 0.05, and 0.10, respectively.

For Panel A, participants were asked to "Please rate the training you completed on the following dimensions:" The questions then listed the words that are in the table under the heading "Variable." Panel B shows the percentage score based on a 44-question test. For Panel C, participants were asked to indicate whether they agreed or disagreed with the statements. For Panels A and C, responses were anchored at 1 = Strongly Disagree, 2 = Disagree, 3 = Somewhat Disagree, 4 = Neither Agree nor Disagree, 5 = Somewhat Agree, 6 = Agree, 7 = Strongly Agree.

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TABLE 2

Experimental Results: Comparison of Gamers and Non-Gamers

Panel A: Comparisons of Satisfaction of Gamers and Non-Gamers: Mean (Std.)

Variable	Gamer	Non-Gamer	t-test
Enjoyable	5.13	5.56	1.06
	(1.36)	(0.92)	
Interesting	5.20	5.50	0.79
	(1.08)	(1.10)	
Boring	3.40	2.44	−2.07**
	(1.50)	(1.15)	
Fun	4.67	5.39	1.78*
	(1.40)	(0.92)	
Informative	5.40	6.11	1.94*
	(1.24)	(0.76)	
Waste of Time	3.07	2.11	−2.15**
	(1.58)	(0.76)	

Panel B: Comparison in Knowledge of Gamers and Non-Gamers: Mean (Std.)

Condition	Gamer	Non-Gamer	t-test
Exam (Percentage Correctly Listed)	54.2%	50.4%	−1.60*
	(5.5%)	(7.8%)	

***, **, * Indicate a significant p-value at $p < 0.01$, 0.05, and 0.10, respectively.

Participants who completed the True Office training were further analyzed by splitting them into gamers and non-gamers. The split was done using a median split of the question: "Currently, about how frequently do you tend to play digital video games (online or console based)?" Responses included (coded value): never (1); less than once a month (2); once a month (3); two to three times a month (4); once a week (5); two to three times a week (6); daily (7). Gamers ($n = 16$) are those individuals who indicated that they play games at least once per month, while non-gamers ($n = 18$) play games less than once a month. Gamers and non-gamers were then compared using the questions asked in Table 1 (see Table 1 for definitions).

marginally significant difference is that participants in the True Office condition are more concerned about privacy after the training than participants in the Thomson Reuters condition (p-value < 0.10).

To test our research question about prior gaming experience, we restrict our analysis to only those participants who completed the True Office training. The results, presented in Table 2, indicate that gamers found True Office to be less fun and informative (p-values < 0.10) and a waste of time and more boring (p-values < 0.05) than non-gamers. Although gamers liked the gaming less, they did answer more questions correctly (p-value < 0.10).[17]

Field Study Results

Tests of H1 using the field study data are presented in Tables 3 and 4. Table 3, Panel A shows employee ratings of True Office training relative to previous non-True Office training on six dimensions. Employees reported True Office training to be more enjoyable, interesting, fun, and informative than previous training. In addition, employees were less likely to rate True Office training as boring or a waste of time, relative to previous non-True Office training. t-statistics indicate that all responses were significantly different from the scale's midpoint ($p < 0.01$). This result provides strong support for H1.

Table 3, Panel B shows employee satisfaction with the True Office training as it pertains to helping them perform their jobs and understand their responsibilities. t-statistics show the average responses are all significantly greater than the midpoint of the scale ($p < 0.01$), indicating that on average, employees were satisfied with the efficacy of True Office as a training tool. Again, this result supports H1.

[17] The data allow us to rule out the possibility that gamers are just somehow better (e.g., more knowledgeable) than non-gamers at this task. When we compare the performance of gamers and non-gamers for participants in the Thomas Reuters and No Training conditions, we find no difference in satisfaction (for the Thomas Reuters participants) or performance on the knowledge test (both conditions) between gamers and non-gamers (all p-values > 0.10). Thus, our results suggest an interaction between the amount of personal time spent playing games and gamified compliance testing such that gamers perform better than non-gamers despite enjoying gamified training less.

TABLE 3

Field Study Results
Satisfaction with Gamification Training and Comparison with Previous Non-Gamification Training

Panel A: Comparison of Gamification Approach to Previous Training Experiences

Variable	Mean (Std. Dev.)	Test against Midpoint
Enjoyable	2.93 (1.67)	−14.41***
Interesting	2.88 (1.55)	−16.37***
Boring	4.49 (1.63)	6.63***
Fun	2.95 (1.41)	−16.61***
Informative	3.11 (1.54)	−13.17***
Waste of Time	4.21 (1.51)	3.09***

Panel B: Satisfaction with Gamification Approach

Question	Mean (Std. Dev.)	Test against Midpoint
This program provided the training content that I needed for my job.	5.64 (1.22)	30.73***
I can better perform my job because of this training.	4.95 (1.59)	13.71***
I understand my responsibilities for protecting information.	5.96 (1.23)	36.63***
I can apply the risk management techniques used in protecting information.	5.87 (1.24)	34.46***
I know the reputational importance of effective information security and the consequences of information being lost or stolen.	6.06 (1.24)	38.04***

***, **, * Indicate a significant p-value at $p < 0.01$, 0.05, and 0.10, respectively.
The results of Table 3 are based on the responses of the 531 employees who completed the survey before receiving True Office training. For Panel A, questions were measured on a seven-point scale anchored at 1 = Strongly Disagree, 2 = Disagree, 3 = Somewhat Disagree, 4 = Neither Agree nor Disagree, 5 = Somewhat Agree, 6 = Agree, 7 = Strongly Agree. For Panel B, participants were asked to "Please compare the most recently completed training by True Office that used an interactive, game-style approach to your last training experience that did not use this approach. Please rate which was better on the following dimensions." The questions then listed the words that are in the table under the heading "Variable." Questions were measured on a seven-point scale anchored at 1 = True Office training, 4 = They were the same, and 7 = Previous non-True Office training. The test against the midpoint reports a t-test comparing the mean against the midpoint of the scale (4).

Table 4 displays employees' ranking of their most-preferred training methods. Panel A shows that 54 percent of responding employees selected True Office game-style approach as the most-preferred method of training. Panel B, which displays the results of t-tests comparing each training method by preference ranking, indicates that the True Office game-style training approach is preferred over every other type of training included in our survey ($p < 0.01$). Results in Tables 3 and 4 strongly support H1, i.e., bank employees prefer the game-style approach of True Office over other types of training methods.

Results testing H2 are shown in Table 5. On average, employees taking the survey after receiving True Office training answered 47.5 percent of the knowledge questions correctly (S.D. = 9.3 percent). In contrast, employees who took the survey before receiving True Office training answered 46.5 percent of the knowledge questions correctly (S.D. = 8.6 percent). The result indicates a slight, marginally statistically significant increase in knowledge for employees receiving True Office training ($t = 1.46$; $p < 0.10$, one-tailed), and provides only minimal support for H2. Although there is some statistical support for H2, the change in scores of 1 percent indicates that in practical matters, the gamified training did not improve knowledge acquisition.

TABLE 4

Field Study Results
Participant Rank Ordering of Different Training Options

Panel A: Descriptive Statistics

Career	Mean (Std. Dev.)	Ranked 1st	Ranked 2nd	Ranked 3rd	Ranked 4th	Ranked 5th
True Office online training using an interactive game-style approach.	1.97	257	84	56	49	31
	(1.27)	(54%)	(18%)	(12%)	(10%)	(7%)
Online training using mostly written materials with voiceover (e.g., PowerPoint presentation with a narrator).	2.36	84	216	83	69	25
	(0.99)	(18%)	(45%)	(17%)	(14%)	(5%)
Online training containing only written material.	3.03	61	114	162	106	34
	(1.11)	(13%)	(24%)	(34%)	(22%)	(7%)
In-person training, with a traditional lecture approach.	3.31	45	47	141	193	51
	(1.17)	(9%)	(10%)	(30%)	(40%)	(11%)
Other	4.33	30	16	35	60	336
	(1.21)	(6%)	(3%)	(7%)	(13%)	(70%)

Panel B: Comparisons between Conditions (Reported Numbers are W-Scores from a Wilcoxon Signed Rank Sum Test)

	True Office	Online Voice	Online Written	In Person
Online training using mostly written materials with voiceover (e.g., PowerPoint presentation with a narrator).	−14,437.5***			
Online training containing only written material.	−30,603***	−25,441***		
In-person training, with a traditional lecture approach.	−37,129***	−30,557***	−9,068.5***	
Other	−47,887.5***	−47,222***	−37,704***	−31,831.5***

***, **, * Indicate a significant p-value at $p < 0.01$, 0.05, and 0.10, respectively.
The results of Table 4 are based on the responses of the 531 employees who completed the survey before receiving True Office training. Participants were asked to rank order (1–5) various training methodologies, including an "Other" category, which allowed for an open-ended text response (options were presented in random order in the study). In Panel A, the mean (Std. Dev.) for the ranking and the count of how many ranked first, second, third, fourth, and fifth is presented. Percentages do not sum to 100 percent because of rounding. In Panel B, Wilcoxon signed rank sum tests are presented for testing median ranking differences between all conditions.

V. DISCUSSION AND CONCLUSIONS

We studied how the gamification of IT security training and data privacy are associated with learner enjoyment and knowledge acquisition. Specifically, in the context of IT security training and data privacy, we hypothesized that gamification would provide positive contributions to participant enjoyment and learning. Using a real-world training module incorporating basic elements of gamification and a non-gamified training module, our results provide evidence that participants enjoy the gamified environment more than other training modalities. But relative to people with less gaming experience, those with more gaming experience enjoyed gamified training to a lesser extent. In terms of knowledge acquisition, we find that while gamification does improve knowledge acquisition relative to no training, it does not outperform non-gamified learning approaches. We offer one caveat to this result. Although they do not like the gamified approach, gamers perform better than non-gamers in knowledge acquisition when using the gamified approach.

We note several limitations in our work. First, the field study is subject to possible recency effects in that we measured satisfaction right after they completed the gamified training. This could result in participants rating this training abnormally high or low because they had an initial strong reaction and were comparing it to previous training they had completed. We mitigated this concern by also conducting a laboratory experiment and by asking questions on the field study in multiple ways. We note that while recency effects may possibly affect the strength of subject reactions, we are unaware of how recency effects would cause directional bias.

Second, we are unable to distinguish the exact characteristics of gamification that can improve or worsen satisfaction and learning. Since this is the first study in accounting on this issue, we believe it was more appropriate to do a general test of gamification, and we encourage future research to examine how specific aspects of gamification affect satisfaction and learning. Future research should also consider the long-term effects of gamification. Meaningful gamification should motivate long-term behavioral changes (Nicholson 2014). Accordingly, future studies examining IT security and data privacy could consider how

TABLE 5

Field Study Results
Participant Knowledge of Information Security Policies

	Took Survey *before* Training			Took Survey *after* Training			
	n	**Mean**	**Std. Dev.**	**n**	**Mean**	**Std. Dev.**	**t-test**
Exam (Percentage Correctly Listed)	325	46.5%	8.6%	531	47.5%	9.3%	1.46*

***, **, * Indicate a significant p-value at $p < 0.01$, 0.05, and 0.10, respectively.
Participants answered 33 questions about the information security policies of the company that were developed by the authors. A t-test comparing the number correct before and after the training is presented. p-values are one-tailed when a directional prediction is made and the results are consistent with the predictions.

shorter duration training on a regular interval might be more or less palatable with a gamified approach. The relevance for this domain is the need to keep employees up to date and vigilant about changing security threats in the external environment. On a more long-term basis, presumably, as the enjoyment and engagement increase, security practitioners could more frequently communicate IT security training issues with less training exhaustion, thereby improving overall employee awareness and knowledge.

Another relevant aspect of IT security and data privacy that merits future research involves considering the long-term and emotional impact evoked by a gamified approach. Our study provides some evidence that gamification caused participants to be more concerned about their own data privacy. It is plausible that a story-based context provided by the True Office training facilitated a better connection between the training material and participants' awareness for their own security and privacy. Future research might explore whether this increased concern results in a longer-term impact in how employees are able to maintain their vigilance against security threats based on receiving gamified or non-gamified training. If gamification promotes long-term vigilance, then it may reduce the need for frequent training, leading to substantial savings for companies in terms of cost and time. From a larger accounting perspective, future studies could examine whether gamification assists in the development of important professional attributes such as increased skepticism and bias reduction, and how the benefits of gamification are affected by personality, experience, and education.

At this stage, gamification does not appear to be the silver bullet needed to increase both enjoyment and learning outright. However, the importance of employee enjoyment cannot be overemphasized given the apathy toward such training and compliance programs noted at the outset of this paper. Further, the gamified approach does not hinder learning. With that in mind, we believe that as this area of research continues to build up both empirical and theoretical volume and rigor, a clearer picture will develop to guide practitioners on matching the right gamifying mechanics with organizational needs.

REFERENCES

Ainley, M., and J. Ainley. 2011a. Student engagement with science in early adolescence: The contribution of enjoyment to students' continuing interest in learning about science. *Contemporary Educational Psychology* 36 (1): 4–12.

Ainley, M., and J. Ainley. 2011b. A cultural perspective on the structure of student interest in science. *International Journal of Science Education* 33 (1): 51–71.

Ainley, M., and S. Hidi. 2014. Interest and enjoyment. In *International Handbook of Emotions in Education,* 205–227. New York, NY: Routledge.

Anderson, J. R. 2005. *Cognitive Psychology and Its Implications*. New York, NY: Worth.

Barata, G., S. Gama, J. Jorge, and D. Gonçalves. 2014. *Relating Gaming Habits with Student Performance in a Gamified Learning Experience*. Proceeding of CHI PLAY 2014, Toronto, ON, Canada, October 19–22.

Berlyne, D. E. 1970. Novelty, complexity, and hedonic value. *Perception & Psychophysics* 8 (5): 279–286.

Breuer, J. S., and G. Bente. 2010. Why so serious? On the relation of serious games and learning. *Eludamos: Journal for Computer Game Culture* 4 (1): 7–24.

Chambers, J., and J. Stewart. 2015. *Why Cybersecurity Leadership Must Start at the Top*. Available at: http://www.forbes.com/sites/frontline/2015/07/13/why-cybersecurity-leadership-must-start-at-the-top/

Committee of Sponsoring Organizations of the Treadway Commission (COSO). 2013. *Internal Control—Integrated Framework*. Available at: http://www.coso.org/IC.htm

American Accounting Association

Cone, B. D., C. E. Irvine, M. F. Thompson, and T. D. Nguyen. 2007. A video game for cyber security training and awareness. *Computers & Security* 26 (1): 63–72.

Connolly, T. M., E. A. Boyle, E. MacArthur, T. Hainey, and J. M. Boyle. 2012. A systematic literature review of empirical evidence on computer games and serious games. *Computers & Education* 59 (2): 661–686.

Daubenfeld, T., and D. Zenker. 2014. *A Game-Based Approach to an Entire Physical Chemistry Course*. Available at: http://www.pubs.acs.org/doi/abs/10.1021/ed5001697

Deterding, S., D. Dixon, R. Khaled, and L. E. Nacke. 2011. *From Game Design Elements to Gamefulness: Defining "Gamification."* Presented at the 2011 MindTrek Conference, Tampere, Finland, September 28–30.

Devers, C. J., and R. A. Gurung. 2015. Critical perspective on gamification in education. In *Gamification in Education and Business,* 417–430. Cham, Switzerland: Springer International Publishing.

Domínguez, A., J. Sáenz-de-Navarrete, L. De-Marcos, L. Fernández-Sanz, C. Pagés, and J.-J. Martínez-Herráiz. 2013. Gamifying learning experiences: Practical implications and outcomes. *Computers & Education* 63: 380–392.

Donovan, L. 2012. *The Use of Serious Games in the Corporate Sector: A State of the Art Report*. Available at: http://www.learnovatecentre.org/wp-content/uploads/2013/06/Use_of_Serious_Games_in_the_Corporate_Sector_PRINT_FINAL.pdf

Downes-Le Guin, T., R. Baker, J. Mechling, and E. Ruylea. 2012. Myths and realities of respondent engagement in online surveys. *International Journal of Market Research* 54 (5): 613–633.

Entertainment Software Association (ESA). 2014. *2014 Sales, Demographic, and Usage Data. Essential Facts about the Computer and Video Game Industry*. Available at: http://www.theesa.com/wp-content/uploads/2014/10/ESA_EF_2014.pdf

Gardiner, B. 2014. *Gamification the New Game Changer? How Enterprise Gamification Is Enhancing Innovation, Change Management and Collaboration*. Available at: http://www.cio.com.au/article/539654/gamification_new_game_changer_/

Gelinas, U., R. Dull, and P. Wheeler. 2011. *Accounting Information Systems*. Mason, OH: Cengage Learning.

Groenfeldt, T. 2014. *NYSE Acquires True Office, Developer of Interactive Game-Style Training*. Available at: http://www.forbes.com/sites/tomgroenfeldt/2014/11/19/nyse-acquires-true-office-developer-of-interactive-game-style-training/

Halter, E. 2006. *From Sun Tzu to Xbox: War and Video Games*. New York, NY: Thunder's Mouth Press.

Hamari, J., J. Koivisto, and H. Sarsa. 2014. *Does Gamification Work?—A Literature Review of Empirical Studies on Gamification*. Available at: http://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=6758978

Karjalainen, M., and M. Siponen. 2011. Toward a new meta-theory for designing information systems (IS) security training approaches. *Journal of the Association for Information Systems* 12 (8): 518–555.

Klamm, B. K., and M. W. Watson. 2009. SOX 404 reported internal control weaknesses: A test of COSO framework components and information technology. *Journal of Information Systems* 23 (2): 1–23.

Koivisto, J., and J. Hamari. 2014. Demographic differences in perceived benefits from gamification. *Computers in Human Behavior* 35: 179–188.

Li, W., T. Grossman, and G. Fitzmaurice. 2014. CADament: A gamified multiplayer software tutorial system. In *Proceedings of the 32nd Annual ACM Conference on Human Factors in Computing Systems*. Available at: https://d2f99xq7vri1nk.cloudfront.net/legacy_app_files/pdf/cadament.pdf

Mayo, M. J. 2007. Games for science and engineering education. *Communications of the ACM* 50 (7): 30–35.

McCallion, J. 2013. *Thomson Reuters and True Office to Gamify Financial Services*. Available at: http://www.itpro.co.uk/645580/thomson-reuters-and-true-office-set-out-to-gamify-financial-services#ixzz3eZmJAVNG

Miller, D. J., and D. P. Robertson. 2011. Educational benefits of using game consoles in a primary classroom: A randomized controlled trial. *British Journal of Educational Technology* 42 (5): 850–864.

Mollick, E. R., and N. Rothbard. 2014. *Mandatory Fun: Consent, Gamification and the Impact of Games at Work*. Available at: http://ssrn.com/abstract=2277103

Nagarajan, A., J. M. Allbeck, A. Sood, and T. L. Janssen. 2012. *Exploring Game Design for Cybersecurity Training*. Available at: http://ieeexplore.ieee.org/xpl/articleDetails.jsp?arnumber=6392562&filter%3DAND%28p_IS_Number%3A6350542%29%26pageNumber%3D2

Nicholson, S. 2014. A RECIPE for meaningful gamification. In *Gamification in Education and Business,* edited by Wood, L., and T. Reiners. New York, NY: Springer.

Novak, E. 2014. Toward a mathematical model of motivation, volition, and performance. *Computers & Education* 74: 73–80.

Pekrun, R., and L. Linnenbrink-Garcia. 2012. Academic emotions and student engagement. In *Handbook of Research on Student Engagement,* edited by Christenson, N. S. L., A. L. Reschly, and C. Wylie, 259–282. New York, NY: Springer.

Pekrun, R., T. Goetz, W. Titz, and R. P. Perry. 2002. Academic emotions in students' self-regulated learning and achievement: A program of qualitative and quantitative research. *Educational Psychologist* 37: 91–105.

Pekrun, R., T. Goetz, A. Frenzel, P. Barchfeld, and R. P. Perry. 2011. Measuring emotions in students' learning and performance: The Achievement Emotions Questionnaire (AEQ). *Contemporary Educational Psychology* 36: 36–48.

Quaranta, S. 2013. *Compliance Training: Make It Relevant to Employees' Jobs*. Available at: http://www.executiveboard.com/blogs/compliance-training-make-it-relevant-to-employees-jobs/

Rantos, K., K. Fysarakis, and C. Manifavas. 2012. How effective is your security awareness program? An evaluation methodology. *Information Security Journal: A Global Perspective* 21 (6): 328–345.

Reeves, B., and J. L. Read. 2009. *Total Engagement: Using Games and Virtual Worlds to Change the Way People Work and Businesses Compete*. Boston, MA: Harvard Business Press.

Ritterfield, U., M. Cody, and P. Vorderer. 2009. *Serious Games: Mechanisms and Effects*. London, U.K.: Routledge.

Romney, M., and P. Steinbart. 2015. *Accounting Information Systems*. Upper Saddle River, NJ: Prentice Hall.

Squire, K. 2003. Video games in education. *International Journal Intelligent Games and Simulation* 2 (1): 49–62.

Susi, T., M. Johanesson, and P. Backlund. 2007. *Serious Games—An Overview*. Available at: http://www.diva-portal.org/smash/get/diva2:2416/FULLTEXT01.pdf

Tomkins, S. S. 1962. *Affect, Imagery, Consciousness: Vol. I. The Positive Affects*. New York, NY: Springer.

Totty, M. 2005. *Business Solutions: Better Training through Gaming*. Available at: http://www.wsj.com/articles/SB111401010367812026

Tulving, E., and N. Kroll. 1995. Novelty assessment in the brain and long-term memory encoding. *Psychonomic Bulletin & Review* 2 (3): 387–390.

van der Heijden, H. 2004. User acceptance of hedonic information systems. *MIS Quarterly* 28 (4): 695–704.

van Kesteren, M. T., D. J. Ruiter, G. Fernández, and R. N. Henson. 2012. How schema and novelty augment memory formation. *Trends in Neurosciences* 35 (4): 211–219.

Virvou, M., G. Katsionis, and K. Manos. 2005. Combining software games with education: Evaluation of its educational effectiveness. *Journal of Educational Technology and Society* 8 (2): 54–65.

Wouters, P., C. van Nimwegen, H. van Oostendorp, and E. D. van der Spek. 2013. A meta-analysis of the cognitive and motivational effects of serious games. *Journal of Educational Psychology* 105 (2): 249–265.

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