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Main article

# Using an educational computer program to enhance student performance in financial accounting

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ABSTRACT

We develop an educational computer program, *Principles Aren't That Hard* (PATH), to enhance intrinsic motivation and performance in accounting education. We include Blackboard and the traditional paper medium as additional system types for comparison purposes. The results show that relative to Blackboard and the traditional paper medium, PATH leads to highest intrinsic motivation, which increases system use. The findings also indicate that the effect of intrinsic motivation on system use is stronger when perceived usefulness is higher than lower. When users perceive a system to be useful for attaining their goals, this form of extrinsic motivation promotes rather than impairs intrinsic motivation which further enhances system use. Additionally, the results suggest that perceived competence fully mediates the impact of system use on performance. This study's identification of perceived competence as a mediator furthers understanding of the inconsistent findings reported in previous research on the effect of system use on performance.



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## 1. Introduction

The objective of educational technology is to enhance accounting education by assisting students in problem-solving (Holcomb & Michaelsen, 1996). Accounting educators are devoting attention to use of educational technology to motivate and assist students to learn technical accounting concepts (Humphrey & Beard, 2014). Online homework software such as Connect, MyAccountingLab, and Wiley Plus have emerged as educational technological tools for facilitating learning. To enhance learning, accounting education includes other educational technological tools such as the Internet (Jensen & Sandlin, 1995), course management software (Jensen & Sandlin, 1992a, 1992b), and Web-based applications (Baker & White, 1999; Murphy & Hoeppner, 2002).

While interesting computer game features can promote learning of technical accounting materials, accounting educators need to recognize that the purpose of computer games is to focus on instruction rather than entertainment. A computer game designed to enhance performance should not be a transformation of an entertainment game or the traditional paper medium. Instead, these computer games should entail educational value with an appropriate level of fun to motivate increased engagement in learning (De Freitas, 2006). Since learner support in a game-based learning environment is essential for positive learning effects, instructional design is a necessary but not sufficient condition for enhanced learning (Garris, Ahlers, & Driskell, 2002; Knotts & Keys, 1997; O'Neil, Wainess, & Baker, 2005).

Despite efforts directed toward the exploration of game features such as fantasy, interactivity, and sensory stimuli of value to education (Law & Sun, 2012), the effect of computer games on performance has not produced consistent results (Leemkuil & de Jong, 2012). While computer games are more effective than the traditional approach such as case studies in terms of knowledge acquisition or mastery of complex situations (Pasin & Giroux, 2011), these benefits are not observed in some studies (Vandercruysse, Vandewaetere, & Clarebout, 2012; Wouters, van der Spek, & Van Oostendorp, 2009). While an extensive analysis reveals the absence of instructional design in most game-based learning studies, only about 10% of these studies can be considered to be based on learning theory (Wu, Hsiao, Wu, Lin, & Huang, 2012). This might shed light on the mixed findings on the impact of computer games on performance.

The purpose of computer games is to obtain desirable learning outcomes and specific learning goals while sustaining user attention. The extant literature focuses on exploration of potential features influencing learning such as feedback types (Svingby, 2010), user experiences (Law & Sun, 2012; Wang & Hsu, 2014), or learning intentions (Kong, Kwok, & Fang, 2012). A need exists for additional work on effectively designing computer games to promote learning of technical accounting materials. To fulfill this need, we design a computer program, *Principles Aren't That Hard* (PATH), to facilitate learning of complex and abstract accounting concepts, which require higher order cognition. Since Blackboard and the traditional paper medium are frequently used in higher education, we examine these delivery formats to facilitate comparison with PATH. PATH is a novel intelligent tutoring system designed to assist learning of technical accounting materials. In particular, PATH incorporates interest-enhancing game features such as animation, enhanced user-computer interaction, appealing interface design, and immediate system feedback (available in certain PATH modules). Such features are limited in Blackboard and almost non-existent in the traditional paper medium.

Relative to a computer instruction system such as Blackboard, a game-based learning environment provides users with a captivating affective experience (Lepper & Cordova, 1992), leading to enhanced engagement (Prensky, 2007). Interesting interfaces can enhance user affective experiences (Baker, D'Mello, Rodrigo, & Graesser, 2010; Mandryk & Atkins, 2007). For example, pedagogical interventions attenuate negative user affect such as boredom and confusion (Baker et al., 2010) and computer-based interventions increase engagement in learning environments over prolonged duration of time (Bickmore, Schulman, & Yin, 2010; Bickmore & Picard, 2005). The benefits of game-based learning include stimulating learner's imagination, promoting curiosity, motivating exploration of challenging tasks (Hoffmann, 2009), and learning via an engaging and enjoyable manner (Law & Sun, 2012). A game-based training strategy promotes intrinsic motivation (Venkatesh, 1999; Venkatesh & Speier, 2000) because lack of intrinsic motivation may cause students to think that they are being forced to go through agonizing learning sessions (D'Mello, Olney, Williams, & Hays, 2012). We expect PATH users to exhibit higher

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intrinsic motivation than Blackboard or traditional paper medium users. Additionally, we identify intrinsic motivation as a mediator that explains the effect of system type (i.e., PATH, Blackboard, or the traditional paper medium) on system use.

The present study contributes to the extant motivation literature by examining the joint effects of intrinsic motivation and perceived usefulness on system use. Consistent with previous research (Davis, Bagozzi, & Warshaw, 1992), this study considers perceived usefulness as a type of extrinsic motivation and posits that the perceived value of computer games (i.e., perceived usefulness) is a critical variable that influences system use. Perceived usefulness measures users' beliefs about the enhancing effect of system use on performance (Yi & Hwang, 2003). While prior research has examined perceived usefulness as an antecedent to behavioral intention to use systems (Lee, Cheung, & Chen, 2005), the current study examines the moderating role of perceived usefulness in the relationship between intrinsic motivation and system use. This study demonstrates a situation where perceived usefulness facilitates rather than debilitates intrinsic motivation.

System use may not necessarily lead to positive learning outcomes (Hou, 2012; Leemkuil & de Jong, 2012; Szajna, 1993). Specifically, while interest-enhancing game features may encourage system use, these attributes may not have a direct effect on performance. Therefore, this study examines whether perceived competence, a construct widely discussed in the motivation literature (Elliot & Harackiewicz, 1994; Harackiewicz & Sansone, 1991), explains these mixed findings.

Undergraduate students enrolled in the introductory financial accounting course participated in this study. They used PATH, Blackboard, or the traditional paper medium to complete their homework. We collected data on the participants' prior knowledge in accounting, computer proficiency, and demographic information during the first day of class. During the last day of class, we obtained measures of the participants' intrinsic motivation, perceived usefulness, perceived competence, their extent of system (i.e., PATH, Blackboard, or the traditional paper medium) usage to do the homework, and knowledge of accounting (i.e., performance).

The next section explains the theory that leads to the hypotheses. The following two sections explain the experimental approach for testing the hypotheses and the results, respectively. The concluding section discusses the findings, contributions, implications and suggestions for future research, and study limitations.

## 2. Theory and hypotheses

### 2.1. Computer games

Computer games assist users to develop abilities, master new skills, accomplish challenging activities, and understand learning materials (Meece, Anderman, & Anderman, 2006). Computer games improve decision-making and problem-solving skills (Wolf, 1972), provide reasoning algorithm training (von Ahn & Dabbish, 2008), enhance learning of basic concepts in introductory courses, and reinforce skills in upper-level courses (Butler, Pray, & Strang, 1979). Researchers and practitioners have investigated the advantageous features of computer games for educational purposes (Law & Sun, 2012). For example, *Civilization*, a computer game demonstrating how world civilizations develop and grow, enhances understanding of history, geography, science, arts, etc. in classrooms around the world. Further, *SimCity*, a city planning computer game, reinforces concepts relating to physics (Kirriemuir & McFarlane, 2003).

A literature review identifies the following game features: fantasy, goals, sensory stimuli, challenge, and control (Garris et al., 2002). These features are of educational interest because they are more engaging and immersive than the traditional paper format. Instructional content embedded in fantasy contexts promotes student interest and learning (Cordova & Lepper, 1996). Fantasies facilitate focused attention and self-absorption when users are immersed in games (Garris et al., 2002). Sound effects, dynamic graphics, and other sensory stimuli facilitate fantasy and attention (Garris et al., 2002). For example, students choose to return to practice activities that include dynamic graphics (Rieber, 1991). Embedding activities in fantasy contexts promotes one's experience of imaginary situations (different from our knowledge of how things work in the real world) which stimulates curiosity (Garris et al., 2002). Goals are also meaningful when activities are linked to valued personal competencies,

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embedded in absorbing fantasy scenarios, or enhanced via competitive motivation. Further, since challenge is associated with improved performance (Keller & Bless, 2008), challenging features such as scores and reward (e.g., bonus questions and the concept of "lives") reinforce positive behavior. Sensory stimuli are also effective for performance feedback (Wilson et al., 2009). Performance feedback and record keeping of scores facilitate tracking of progress toward desired goals (Garris et al., 2002). User-friendly interfaces increase user interaction and cognitive processing, resulting in improved learning (Bryant & Hunton, 2000).

### 2.2. PATH

We design an accounting educational computer program, PATH, which incorporates game features to enhance intrinsic motivation and performance in mastering technical accounting materials. Users progress through the PATH modules at their own pace, leading to increased perception of autonomy, which enhances intrinsic motivation. The challenging features and intangible reward systems (e.g., bonus questions and the concept of lives) embedded in PATH are expected to facilitate performance. While challenging features that facilitate objective outcomes and performance feedback help students to interpret their success in achievement situations (Meece et al., 2006), immediate scoring communicates specific goals and current performance, which increase commitment and self-improvement (Locke & Latham, 1990). When performance is below desired goals, individuals respond to the feedback–standard discrepancy by increasing their effort to attain the standard (Garris et al., 2002). The explanation or performance feedback feature in PATH assists users to monitor their progress and promote a positive attitude toward learning.

#### 2.2.1. The effect of system type on intrinsic motivation

Intrinsic motivation refers to performance of an activity for the sake of pleasure and satisfaction inherent in the activity itself (Deci & Ryan, 1985a). When individuals are intrinsically motivated, they are willing to devote effort because of the interest and enjoyment derived from engagement in the activity (Ryan & Deci, 2000). Intrinsic motivation exerts a more powerful and sustainable influence on individual behavior than external rewards (Deci & Ryan, 2000). A novel technology (e.g., PATH) adds value by expanding information to allow users to manage and control their learning process by taking advantage of the technology's increased flexibility and convenience in learning (i.e., technology removes the constraints associated with time and place) (Johnson, Hornik, & Salas, 2008). Enhanced learning ensues when users experience increased control over the pace, flow, and interaction with a system (Johnson et al., 2008).

Interest-enhancing features such as animation, interactivity, and appealing interface design increase user control and motivation for learning, which increase one's intrinsic motivation to use a system. This study incorporates these features in PATH to facilitate intrinsic motivation. Relative to PATH, the extent of animation, interactivity, and appealing interface design is limited in Blackboard. Therefore, intrinsic motivation is predicted to be lower for Blackboard than PATH users. Absence of interest-enhancing attributes in the traditional paper medium suggests that intrinsic motivation is lower for the traditional paper medium than Blackboard users. This leads to the first hypothesis (stated in the alternative) as follows:

H1a. Intrinsic motivation is highest for PATH users followed by Blackboard and the traditional paper medium users, respectively.

#### 2.2.2. The mediating effect of intrinsic motivation

Information systems research has investigated the pivotal role of intrinsic motivation in system use (Davis et al., 1992; Venkatesh, 2000; Venkatesh & Speier, 1999, 2000). In particular, motivation theory is adapted extensively to fit specific contexts to further understanding of adoption and use of technology (Davis et al., 1992; Venkatesh & Speier, 1999). Interfaces that reduce cognitive effort or incorporate a certain degree of challenge promote interest in a task, which enhances system use (Pilke, 2004). Strategies such as autonomous job design and socialization tactics facilitate intrinsic motivation and increase system use (Ke, Tan, Sia, & Wei, 2012). Hence, hypothesis 1a proposes that system

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type (i.e., PATH, Blackboard, or the traditional paper medium) affects the users' intrinsic motivation. This prediction coupled with the expected effect of intrinsic motivation on system use suggests the potential mediating effect of intrinsic motivation in the relationship between system type and system use. The mediating hypothesis is formally stated as follows:

H1b. Intrinsic motivation mediates the effect of system type on system use.

### 2.3. The moderating role of perceived usefulness

The extant literature has examined the impact of perceived usefulness on system use (Davis, 1989; Segars & Grover, 1993; Subramanian, 1994; Szajna, 1994). Perceived usefulness refers to the belief that use of a system improves one's performance (Davis, 1989). Users may use systems when they see the value of usage such as enhanced learning or increased control over the learning process (Hornik, Johnson, & Wu, 2007). A meta-analysis concludes that training transfer occurs when one perceives value in the training activity (Alliger, Tannenbaum, Bennett, Traver, & Shotland, 1997).

Motivation theory suggests that both intrinsic and extrinsic motivations drive human behaviors, and extrinsic motivation either facilitates or undermines the effect of intrinsic motivation on individual behavior (Ryan & Deci, 2000). When people are rewarded for the performance of an interesting activity, they exhibit less interest in and willingness to work on the same activity upon termination of the reward compared to those who participate in the activity without any reward (Deci & Ryan, 1985a). This phenomenon, defined as the undermining effect (Deci & Ryan, 1980), occurs when rewards are expected (Lepper, Greene, & Nisbett, 1973), salient (Ross, 1975), and contingent on task engagement (Ryan, Mims, & Koestner, 1983). Prior motivation studies indicate that participants consider material rewards (Deci, 1972), threats of punishment (Deci & Cascio, 1972), evaluations (Smith, 1974), deadlines (Amabile, DeJong, & Lepper, 1976), imposed goals (Mossholder, 1980), and good player awards (Lepper et al., 1973) as controlling factors that impede intrinsic motivation. Although one's intrinsic task interest can be undermined by the prospect of reward during task performance, expectation of a reward improves performance and may offset this effect (Deci & Ryan, 1985b). While extrinsic rewards impair intrinsic motivation when the controlling aspect of the evaluative contingencies is elicited, extrinsic incentives promote intrinsic motivation when the evaluative outcome provides competency information to users (Harackiewicz, Manderlink, & Sansone, 1984). This suggests that system use increases when users perceive it to be useful for attaining their goals (i.e., improved performance). The next hypothesis (stated in the alternative) examines whether higher (lower) perceived usefulness strengthens (weakens) the positive impact of intrinsic motivation on system use (discussed in hypothesis 1a):

H2. The effect of intrinsic motivation on system use is stronger when perceived usefulness is higher than lower.

### 2.4. The mediating role of perceived competence

Perceived competence refers to feelings or perceptions of competence with respect to an activity or domain (Deci & Ryan, 1980, 1985a). Perceived competence facilitates goal attainments and provides individuals with a sense of need satisfaction from engagement in an activity that they feel competent at (Deci & Ryan, 2000). Perceived competence is positively related to performance regardless of the presence of external rewards (Arnold, 1985); specifically, it is a significant predictor of domain-specific academic performance, after controlling for achievement test scores in educational research (Miserandino, 1996). Individuals' perceptions of competency drive their performance expectations, which motivate them to achieve their desired goals (Elliot & Church, 1997). When competence or autonomy is perceived as unfulfilled, participants report negative affect and withdrawal behavior, which impair their performance (Miserandino, 1996).

Despite the advantages of computer games in enhancing learning, the literature is equivocal on the relationship between system use and learning outcome (Leemkuil & de Jong, 2012). While some studies report a positive effect (Doll & Torkzadeh, 1998; Goodhue & Thompson, 1995; Hou, 2012; Igbaria & Tan, 1997), others find a negative impact (Pentland, 1989; Szajna, 1993) or an insignificant effect

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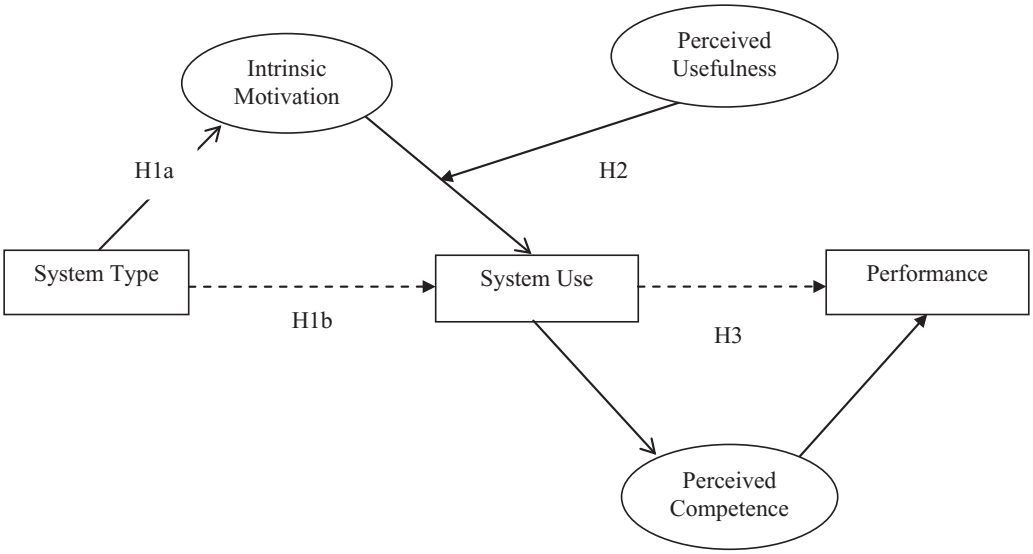


**Fig. 1.** Research model. H1a: Effect of system type on intrinsic motivation. H1b: Indirect effect of system type on system use through intrinsic motivation. H2: Moderating effect of perceived usefulness in the relationship between intrinsic motivation and system use. H3: Indirect effect of system use on performance through perceived competence.

(Gelderman, 1998; Lucas & Spitler, 1999) of system use on performance. This study posits that perceived competence may explain the mixed findings of system use on performance. That is, perceived competence is expected to increase usage of a system to complete a given task when individuals believe that such usage will result in improved performance. Finally (stated in the alternative form):

H3. Perceived competence mediates the effect of system use on performance.

Fig. 1 displays the research model depicting the above hypothesized relationships.

## 3. Experimental method

### 3.1. Participants

A total of 173 undergraduate students enrolled in four sections of the introductory financial accounting course participated in this study.[1] Students in two sections of the course used PATH (87) while the remaining sections used Blackboard (46) or the traditional paper medium (40), respectively to complete their homework. About 72% of the participants were females and their average age was 20.

### 3.2. Procedures

One of the authors administered the experiment. On the first day of class, participants received the same course syllabus except for the section that stated that they would complete the homework assignments via PATH, Blackboard or the traditional paper medium, depending on their respective treatment conditions. The instructor indicated that the purpose of the study was to examine how students learned the course materials. Participants were told that all the consent forms would be kept in a sealed envelope and analysis of the data would not commence until after all the final course grades had been

[1] Participants were randomly assigned to the treatment conditions because they enrolled in different sections of the course on their own accord.

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submitted. Participants then completed a 10-item questionnaire assessing their prior knowledge in accounting. They also indicated their computer proficiency and responded to the demographic questions. Participants absent during the first day of class were given the materials at the start of the next class and requested to complete the questionnaire outside the classroom. This procedure was necessary to ensure that the participants understood and completed the required materials before they received their first instruction. During the last day of class, participants completed the intrinsic motivation, perceived usefulness, and perceived competence scales. They also indicated the extent of their usage of the system (i.e., PATH, Blackboard, or the traditional paper medium) to do the homework and answered the same 10 questions (i.e., the performance measure) that they completed during the first day of class.

### 3.3. Constructs

#### 3.3.1. System type

The homework materials were the same for all the participants, regardless of whether they used PATH, Blackboard or the traditional paper medium to complete the homework.[2] The only difference was the presentation of the homework materials via their respective treatment conditions (i.e., PATH, Blackboard, or the traditional paper medium).[3]

*3.3.1.1. PATH.* The PATH[4] group received a CD containing 10 PATH modules (i.e., 10 sets of homework assignments) during the first day of class. A demo or directions screen was available for guiding users on using PATH to complete the homework. At the end of each PATH module, a statistics screen displayed the user's first name initial and last name, date, time, score (if available), number of lives lost (if available), percentage of correct answers, and summary of incorrect answers (if applicable). The scores, number of lost lives, and bonus questions (if available) added realism to use of a computer game in the context of learning. The PATH modules included none, limited, or rich animation.[5] Some PATH modules provided explanation for an incorrect answer either automatically or when the users chose to read the explanation. Further, certain PATH modules included bonus questions; that is, a bonus question appeared when a user consecutively answered a series of questions correctly. The bonus questions[6] mimicked an educational computer game context that stimulated the users' interest in learning and provided insight into their understanding of the materials. The screen shots of selected PATH modules are shown in Fig. 2.

*3.3.1.2. Blackboard.* Blackboard users completed the homework assignments programmed in a database on Blackboard. At the end of each homework assignment, Blackboard provided users with the correct answers, incorrect answers, and explanations.

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[2] All the participants completed the homework assignments via PATH, Blackboard or the traditional paper medium outside class time. They could work on the homework assignments as much or as little as they wished.

[3] For example, in Module 1, a specific account (e.g., prepaid salaries, selling expense, repairs revenue, etc.) and possible classifications of the account (i.e., asset, liability, owners' equity, revenue, and expense) are presented in PATH with graphic images on the background. A user may click on "Expense" (i.e., the classification) for selling expense. In Blackboard, the accounts are displayed in the left column and the classifications are presented as choices in the right column. A user may click on the "Expense" classification for selling expense. The traditional paper medium displays all the accounts in the left column titled "Account Title." A user would write the classification for this account in the right column titled "Account Category." A user may write "Expense" in the "Account Category" column for selling expense.

[4] PATH is not commercially available. One of the authors worked with a programmer and a graphics designer to develop PATH to increase student interest in learning the materials in the introductory financial accounting course.

[5] The PATH modules comprising the 10 homework assignments have different levels of animation. For example, the first three modules focus on basic financial accounting concepts such as account categories (assets, liabilities, expenses, revenues, and owners' equity) (Module 1), debits/credits (Module 2), and financial statement accounts (Module 3). While Modules 1 and 3 contain graphic images with no animation, Module 2 includes certain vivid images (i.e., limited animation). The degree of animation is high in Module 4 because vivid images are embedded into identification of the effect of a transaction; that is, whether a transaction increases or decreases assets, liabilities, owners' equity, revenues, and expenses).

[6] The Blackboard and traditional paper medium users did not receive the bonus questions. The PATH users' scores on the bonus questions were excluded from their homework grade.

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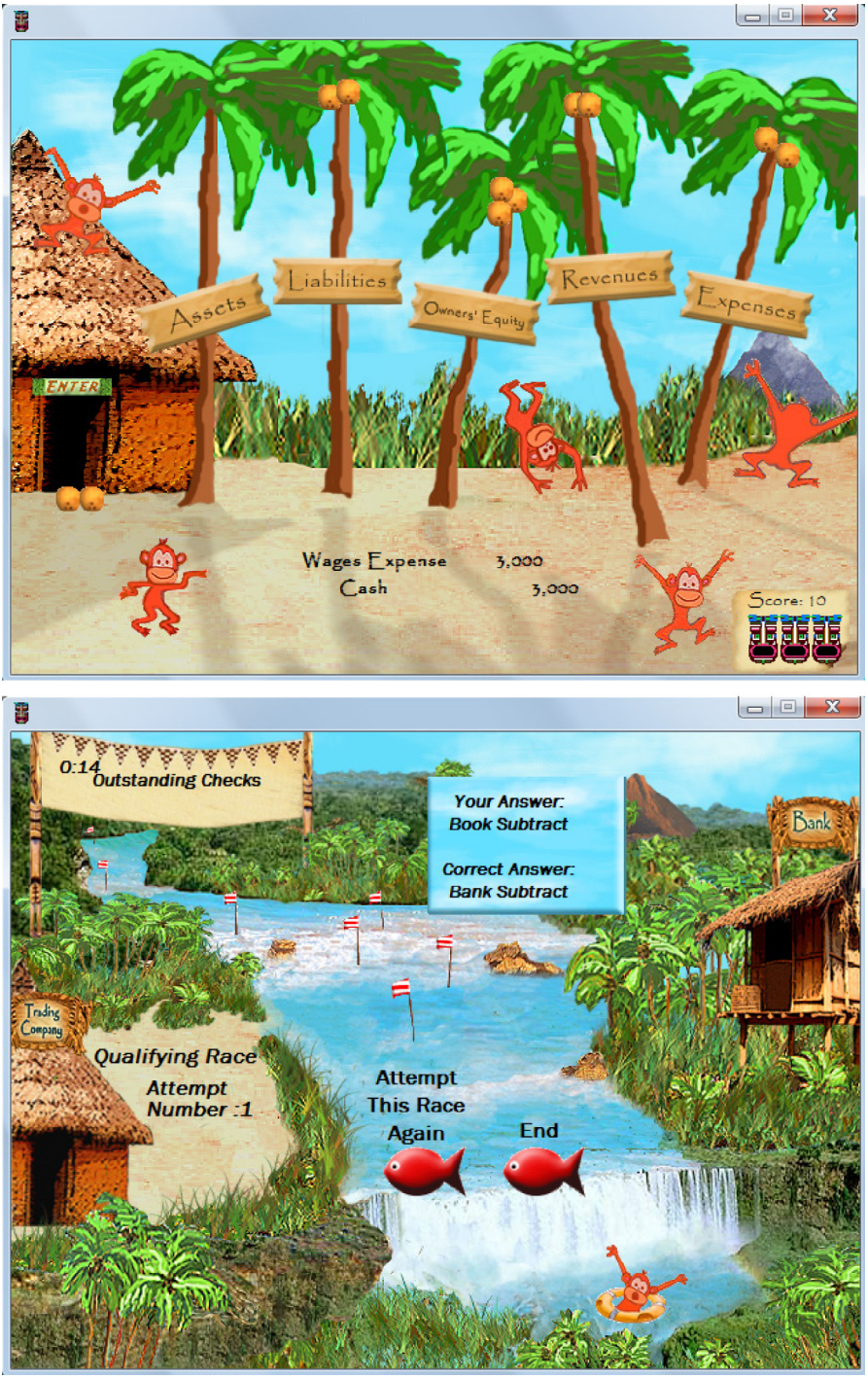


**Fig. 2.** Screen shots of selected PATH modules.

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**Table 1**
Scale items.

| | Measures | 7-Point scale end-points |
|---|---|---|
| Intrinsic motivation | | |
| IM1 | I found *using PATH to do* (or *using Blackboard to do*; or *doing*) homework very interesting. | – Not at all true<br>– Very true |
| IM2 | *Using PATH to do* (or *Using Blackboard to do*; or *Doing*) homework was fun. | – Not at all true<br>– Very true |
| IM3 | I would describe *using PATH to do* (or *using Blackboard to do*; or *doing*) homework as very enjoyable. | – Not at all true<br>– Very true |
| Perceived usefulness | | |
| PU1 | I believe that *using PATH to do* (or *using Blackboard to do*; or *doing*) homework was of some value to me. | – Not at all true<br>– Very true |
| PU2 | I think *using PATH to do* (or *using Blackboard to do*; or *doing*) homework is useful. | – Not at all true<br>– Very true |
| PU3 | I think *using PATH to do* (or *using Blackboard to do*; or *doing*) homework is important. | – Not at all true<br>– Very true |
| PU4 | I think that *using PATH to do* (or *using Blackboard to do*; or *doing*) homework is helpful. | – Not at all true<br>– Very true |
| PU5 | I believe that *using PATH to do* (or *using Blackboard to do*; or *doing*) homework could be beneficial to me. | – Not at all true<br>– Very true |
| Perceived competence | | |
| PC1 | I think I did pretty well at *using PATH to do* (or *using Blackboard to do*; or *doing*) homework, compared to other students. | – Not at all true<br>– Very true |
| PC2 | I am satisfied with my performance at *using PATH to do* (or *using Blackboard to do*; or *doing*) homework. | – Not at all true<br>– Very true |
| PC3 | I felt pretty skilled at *using PATH to do* (or *using Blackboard to do*; or *doing*) homework. | – Not at all true<br>– Very true |
| PC4 | After *using PATH to do* (or *using Blackboard to do*; or *doing*) homework for a while, I felt pretty competent. | – Not at all true<br>– Very true |

*3.3.1.3. Traditional paper medium.* The traditional paper medium users received the homework assignments (on paper) from the instructor in class. The instructor provided feedback (on paper) on these students' assignments.

*3.3.2. Intrinsic motivation, perceived usefulness, and perceived competence*

We modified the interest/enjoyment, perceived usefulness, and perceived competence subscales of the Intrinsic Motivation Inventory instrument validated and used in previous studies (Deci, Eghrari, Patrick, & Leone, 1994; Ryan, Connell, & Plant, 1990; Ryan, Koestner, & Deci, 1991). The interest/enjoyment scale is considered as a self-report measure of intrinsic motivation and the only scale that assesses intrinsic motivation (Self-determination theory, 2016). Thus, this study used the interest/enjoyment as a self-report measure of intrinsic motivation. Since some of the items in the intrinsic motivation were repetitive in nature, we used the 3-item scale that focused on the attributes of fun, interest, and enjoyment. We used the 5-item perceived usefulness and 4-item perceived competence scales because one item in each of these scales appeared to be repetitive.[7] Table 1 presents the items for the intrinsic motivation, perceived usefulness, and perceived competence scales.

*3.3.3. System use*

System use was the participants' self-reported extent of usage of homework materials delivered via their respective systems to prepare for the exam. We measured this construct using the following question (on a 7-point scale with 1 = very little; 7 = to a great extent): "*I often use the homework materials in PATH to prepare for exam*" (PATH), "*I often use the homework materials in Blackboard to prepare for exam*" (Blackboard), or "*I often use the homework materials to prepare for exam*" (traditional paper medium).

[7] Similar results are obtained when all the items in the intrinsic motivation, perceived usefulness, and perceived competence scales are included in the analysis.

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**Table 2**
Reliability analysis.

| | Cronbach's alpha | Composite reliability | AVE |
|---|---|---|---|
| Intrinsic motivation | 0.891 | 0.928 | 0.811 |
| Perceived usefulness | 0.860 | 0.901 | 0.648 |
| Perceived competence | 0.822 | 0.884 | 0.658 |

**Table 3**
Loadings and cross loadings.

| Variable | Intrinsic motivation | Perceived usefulness | Perceived competence |
|---|---|---|---|
| IM1 | **0.878** | 0.345 | 0.283 |
| IM2 | **0.909** | 0.285 | 0.354 |
| IM3 | **0.914** | 0.222 | 0.285 |
| PU1 | 0.386 | **0.731** | 0.455 |
| PU2 | 0.249 | **0.806** | 0.452 |
| PU3 | 0.190 | **0.732** | 0.291 |
| PU4 | 0.187 | **0.871** | 0.531 |
| PU5 | 0.255 | **0.872** | 0.481 |
| PC1 | 0.178 | 0.300 | **0.751** |
| PC2 | 0.277 | 0.433 | **0.813** |
| PC3 | 0.346 | 0.429 | **0.899** |
| PC4 | 0.282 | 0.613 | **0.773** |

Numbers in bold represent the factor loadings for each latent construct, while those not in bold represent the cross-loadings.

#### 3.3.4. Performance

We measured performance using each participant's score (ranging from zero to 10 correct answers) on 10 questions, which assessed competency in the course materials after usage of their respective systems to complete the homework. These questions were similar to the exam questions to facilitate a connection between the system use and performance constructs. The questions were considered critical for testing the participants' knowledge of important financial accounting concepts (see Appendix). The homework assignments reinforced understanding of these important concepts to increase mastery of essential knowledge for improved performance on the 10 assessment questions.

### 3.4. Construct validation

We used Smart PLS to test the construct reliability, and convergent and discriminant validity of the three latent constructs (i.e., intrinsic motivation, perceived usefulness, and perceived competence). As Table 2 indicates, the Cronbach's alpha and composite reliability scores exceed the threshold of 0.7 (Hair, Anderson, Tatham, & Black, 1998), suggesting reliable internal consistency. Average variance extracted (AVE) and factor loadings are used to assess convergent validity. All the AVE values are greater than the recommended threshold of 0.5 (Chin, 1998; Fornell & Larcker, 1981). The factor loadings (Table 3) of the three latent constructs are all above 0.7, exceeding the cut-off value of 0.5 suggested by Chin (1998). Hence, the results demonstrate acceptable convergent validity.

The factor loadings of the items are also higher on their respective constructs than on other constructs (Table 3), and the AVE square root of each latent construct is higher than its correlation with the remaining latent variables (Table 4). Thus, the requirements of discriminant validity are fulfilled.

### 3.5. Common method bias

We used the procedural and statistical techniques of Podsakoff, MacKenzie, Lee, and Podsakoff (2003) to control for any potential effect of common method bias in this study. First, the system type variable is obtained from a different source (i.e., manipulated) than the measured variables. Second, the mea-

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**Table 4**
Correlations of latent constructs.

| | Intrinsic motivation | Perceived usefulness | Perceived competence |
|---|---|---|---|
| Intrinsic motivation | 0.901[a] | | |
| Perceived usefulness | 0.313 | 0.805[a] | |
| Perceived competence | 0.342 | 0.554 | 0.811[a] |

[a] AVE square root.

sured variables are based on various response formats, which create a methodological separation of measurement between the predictor and criterion variables (Podsakoff et al., 2003). For example, intrinsic motivation was measured using three items on a 7-point scale while performance was assessed using the composite score of 10 questions.

We conducted the Harman's single factor test, a widely used statistical technique, to examine the possible effect of common method bias. An exploratory factor analysis of all the latent and manifest variables in the research model assesses whether a single factor explains most of the variance in the data, which suggests a common method bias. The results yielded three factors with an eigenvalue greater than 1 and the first factor accounted for 36.3% of the variance. Thus, common method bias does not seem to pose a problem in this study.

Additionally, we employed the marker variable technique (Lindell & Whitney, 2001) to test for common method bias. A marker variable is theoretically uncorrelated with at least one construct (focal variable) examined in the study. A high correlation between the marker and focal variables indicates the presence of common method variance. We used the participants' reported proficiency in Microsoft Word as the marker variable. No significant correlation is observed between this marker and focal variables (i.e., system use and performance). The average correlation is 0.058 (ranging from 0.004 to 0.107). The results corroborate the Harman's single factor test results which suggest that common method bias does not have a significant effect in this study.

Further, we used two other sophisticated methods (control for affectivity and control for general latent method factor) recommended by Podsakoff et al. (2003) to examine the existence of common method bias in this study. In the first method, we measured the participants' affectivity using their responses to the following two questions (on a 7-point scale): "*How much do you like accounting*" (1 = a little; 7 = a lot) and "*How likely will you choose accounting as your major*" (1 = not at all likely; 7 = very likely). These two questions comprised the latent affectivity factor. The scale items were allowed to load on their own constructs as well as on the latent affectivity factor. Inclusion of this affectivity factor did not affect the model results. In the second method, the scale items were allowed to load on a latent common method bias factor and also on their own theoretical factors. Similar results were obtained with or without the common method bias factor.

In sum, the results of the four techniques (i.e., Harman's single factor test, marker variable technique, control for affectivity, and control for general latent method factor) indicate that common method bias does not affect the model results of this study.

## 4. Data analysis and results

### 4.1. Measurement model

We used structural equation modeling (SEM) to test the proposed hypotheses. SEM is particularly useful when the research model involves relationships among the latent constructs, and between the latent constructs and the measures of these constructs (Edwards & Bagozzi, 2000). As shown in Fig. 1, this study involves three latent constructs: intrinsic motivation, perceived usefulness, and perceived competence. SEM does not make distributional assumptions about exogenous (i.e., independent) variables (Kline, 2005). Thus, the unequal sample sizes in the three treatment conditions (i.e., PATH, Blackboard, and the traditional paper medium) do not affect the SEM results.

Mplus software was used to test the SEM models in this study. Compared to smart PLS and AMOS, Mplus allows a direct test of interactions between the latent constructs (i.e., intrinsic motivation and

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perceived usefulness). In addition, the indirect effect function of MPlus is used to conduct the mediating test. The measurement model is evaluated by testing the measures of all the constructs simultaneously via confirmatory factor analysis (Cheng, 2001) to facilitate evaluation of convergent and discriminant validity. Mplus also allows inter-correlations among the latent constructs (Cheng, 2001), and provides the model fit indices for assessing the validity and reliability of the model. The model fit indices[8] [comparative fit index (CFI) = 0.953, root mean square error of approximation (RMSEA) = 0.061, standardized root mean square residual (SRMR) = 0.082] reveal a good model fit for the measurement model (the three latent constructs and their measures). The factor loadings of the three latent constructs (i.e., intrinsic motivation, perceived usefulness, and perceived competence) are sufficiently high and statistically significant ($p < 0.001$). Hence, the results demonstrate a highly reliable measurement model and assure the quality of the subsequent structural model.

### 4.2. Structural model

The model fit indices (i.e., CFI, RMSEA and SRMR) for the structural model are not available because the model involves interactions between two latent constructs and between a latent construct and a manifest variable. Hence, we assessed the model fit for the structural model by comparing the Akaike information criterion (AIC) and Bayesian information criterion (BIC) values of the model with and the model without the latent interaction terms. Smaller AIC and BIC values indicate a better model fit (Burnham & Anderson, 2004). The fit indices for the model without the interaction terms (CFI = 0.959; RMSEA = 0.059; SRMR = 0.059) suggest a good model fit. Additionally, the model with the interaction term (i.e., the structural model) has smaller AIC and BIC values,[9] indicating a better model fit. Thus, the structural model meets the requirements of a good model fit.

#### 4.2.1. Control variables

The participants' age, gender, grade point average, class standing, pretest performance score, proficiency in word processing/spreadsheet/database/computer games, extent of their liking for accounting, and their intention to major in accounting were included as covariates in the research model. Except for the significant effect of the extent of the participants' liking for accounting on performance, all the control variables did not have a significant effect on the dependent variables (i.e., system use and performance) or model results (untabulated) and were excluded from further analysis. We included the extent of the participants' liking for accounting in the research model and similar results were obtained with or without this variable. Thus, the model results are presented without this factor.

#### 4.2.2. Model results

Fig. 3 presents the results of the hypotheses in the model.

#### 4.2.3. Mediating effect of intrinsic motivation

The significant positive path from system type (1 = traditional paper medium, 2 = Blackboard, and 3 = PATH) to intrinsic motivation ($\beta = 0.635$; $p < 0.001$) indicates that PATH leads to the highest intrinsic motivation. The planned contrast results also suggest that the PATH users exhibit the highest intrinsic motivation (mean of 4.54). Specifically, the average intrinsic motivation score of PATH users is 1.13 higher than the average intrinsic motivation score of Blackboard users ($p < 0.001$), and 1.99 higher than the average intrinsic motivation score of the traditional paper medium users ($p < 0.001$). Additionally, the average intrinsic motivation score of Blackboard users is 0.86 ($p < 0.01$) higher than

[8] This study used the following three indices to measure model fit: comparative fit index (CFI), root mean square error of approximation (RMSEA), and standardized root mean square residual (SRMR). CFI value of 0.90 indicates a good fit while values of 0.95 or above represent an excellent fit (Hu & Bentler, 1999; Kline, 2005). RMSEA declines when the model fit improves (Steiger, 1990; Steiger & Lind, 1980). Thus, an RMSEA value of 0.06 or below suggests a good model fit. A SRMR value of 0.09 or below also indicates a good model fit (Browne & Cudeck, 1993; Hu & Bentler, 1999).

[9] The AIC and BIC values for the model with (without) the interaction term are 6690.650 (7022.220) and 6849.143 (7211.418), respectively.

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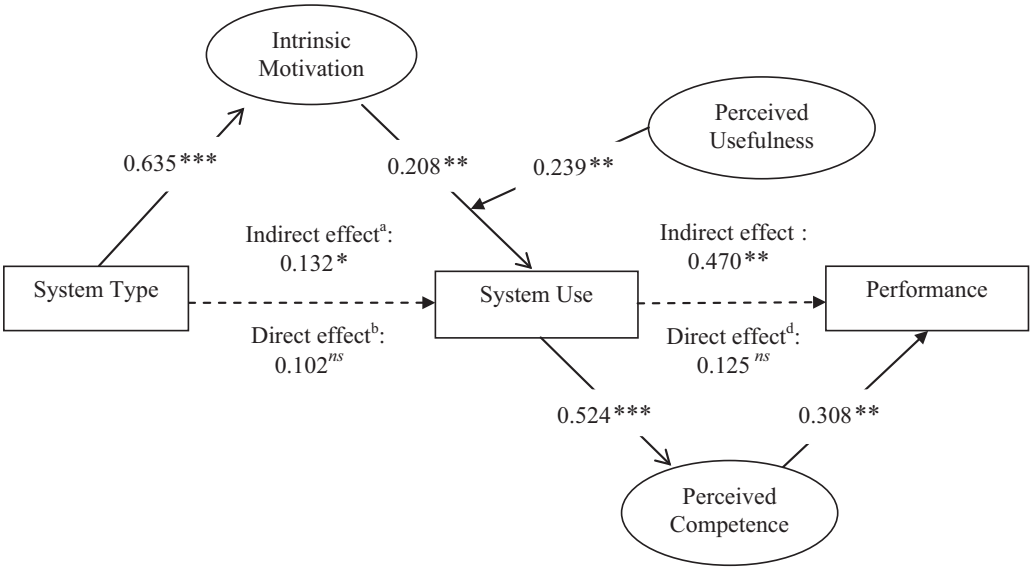


**Fig. 3.** Model results. *p < 0.05, **p < 0.01, ***p < 0.001, ns = not significant. [a]Indirect effect refers to the effect of system type on system use through intrinsic motivation. [b]Direct effect refers to the effect of system type on system use. [c]Indirect effect refers to the effect of system use on performance through perceived competence. [d]Direct effect refers to the effect of system use on performance.

the average intrinsic motivation score of the traditional paper medium users. Thus, hypothesis 1a is supported.

The mediating role of intrinsic motivation in the relationship between system type and system use was tested using the SEM indirect effect function, an approach consistent with Baron and Kenny (1986). An indirect effect tests the mediating effect of a variable on the relationship between two variables (Weston & Gore, 2006). A full mediating effect occurs when the relationship between two variables (i.e., direct effect) is not significant in the presence of the significant indirect effect. A partial mediator is present when both the direct and indirect effects remain significant. As depicted in Fig. 3, the path from system type to intrinsic motivation is positive and significant ($\beta = 0.635$; $p < 0.001$). The link from intrinsic motivation to system use is also positive and significant ($\beta = 0.208$; $p < 0.01$). Further, the indirect effect of system type on system use via intrinsic motivation is significant ($\beta = 0.132$; $p < 0.05$) while the direct effect is no longer significant. These results suggest the full mediating effect of intrinsic motivation in the relationship between system type and system use. Therefore, hypothesis 1b is supported.

*4.2.4. Moderating effect of perceived usefulness*

As shown in Fig. 3, the significant positive interaction effect of intrinsic motivation and perceived usefulness on system use ($\beta = 0.239$; $p < 0.01$) provides support for hypothesis 2. Additionally, consistent with the procedures of Aiken and West (1991), we used two regressions to provide additional insight into the moderating effect of perceived usefulness in the relationship between intrinsic motivation and system use. The first regression model results (Table 5, Model I) reveal that the main effects of intrinsic motivation ($\beta = 0.235$; $p < 0.01$) and perceived usefulness ($\beta = 0.243$; $p < 0.01$) on system use are positive and significant. When the interaction term, intrinsic motivation × perceived usefulness, is included in the second regression model (Table 5, Model II), the results show a significant positive interaction effect ($\beta = 0.369$; $p < 0.001$) while the main effects of intrinsic motivation and perceived usefulness on system use are no longer significant. Further, the change in $R$ squared (i.e., $R$ squared increased by 0.136) between the main effects regression model and the main effects and interaction

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**Table 5**
Additional moderator testing.

| Independent variables | Dependent variable: System use | |
|---|---|---|
| | Model I | Model II |
| Intrinsic motivation | 0.235** | 0.005 ns |
| Perceived usefulness | 0.243** | 0.034 ns |
| Intrinsic motivation × perceived usefulness | NA | 0.369*** |

*p < 0.05, **p < 0.01, ***p < 0.001, ns = not significant.

effect regression model is significant ($p < 0.001$). The results suggest the presence of a complete moderator. The positive interaction sign indicates that perceived usefulness increases the impact of intrinsic motivation on system use.

*4.2.5. Mediating effect of perceived competence*

Fig. 3 reveals the significant effects of system use on perceived competence ($\beta = 0.524$; $p < 0.001$), and perceived competence on performance ($\beta = 0.308$; $p < 0.01$). The indirect effect of system use on performance through the mediator, perceived competence, is significant ($\beta = 0.470$; $p < 0.01$), while the direct effect of system use on performance is no longer significant. Hence, a full mediating effect is observed, supporting hypothesis 3.

*4.3. Additional analysis*

The participants' self-reported usage of their respective systems to complete the homework varied between 1 and 7 and the mean was 5. This suggested that participants were aware that they could choose to use the materials delivered via their respective systems as much or as little as they wished. This finding was consistent with this study's focus on the extent of usage of the system, which influenced performance.

The participants' performance[10] before (i.e., pretest) and after (i.e., posttest or performance construct) usage of their respective systems were compared and the *t*-test results showed that the scores were significantly higher ($p < 0.001$) in the posttest (mean of 5.85) than in the pretest (mean of 1.07), indicating an overall positive learning effect from pretest to posttest. Additionally, pretest performance did not vary significantly among the three treatment groups of PATH, Blackboard, and the traditional paper medium ($F = 0.087$; $p = 0.971$; means = 1.06, 1.13, and 1.03, respectively). This result corroborates our earlier finding of lack of significant impact of pretest performance on the overall model results.

*4.3.1. Main effects*

As illustrated in Fig. 3 and Table 6, the two mediation test results suggest positive significant main effects of (1) intrinsic motivation on system use, (2) system use on perceived competence, and (3) perceived competence on performance. Additional SEM analysis indicates that the three different system types directly influence perceived competence ($\beta = 0.272$; $p < 0.05$) and the positive coefficient suggests that perceived competence is highest for PATH users compared to Blackboard and the traditional paper medium users. The results also reveal that intrinsic motivation enhances perceived competence ($\beta = 0.374$; $p < 0.001$). Table 6 summarizes the results of these main effects.

*4.3.2. Multiple group analysis*

We performed the SEM multiple group analysis (using Mplus) to examine whether similar results were obtained for the three system types (i.e., PATH, Blackboard, and the traditional paper medium).

[10] The participants' scores on questions assessing their performance in the course materials were measured before (i.e., pretest) and after (i.e., posttest) the study.

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**Table 6**
Results of main effects.

| Independent variable | Dependent variable | Coefficient |
|---|---|---|
| System type | Intrinsic motivation | 0.635*** |
| Intrinsic motivation | System use | 0.208** |
| System use | Perceived competence | 0.524*** |
| Perceived competence | Performance | 0.308** |
| System type | Perceived competence | 0.272* |
| Intrinsic motivation | Perceived competence | 0.374*** |

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

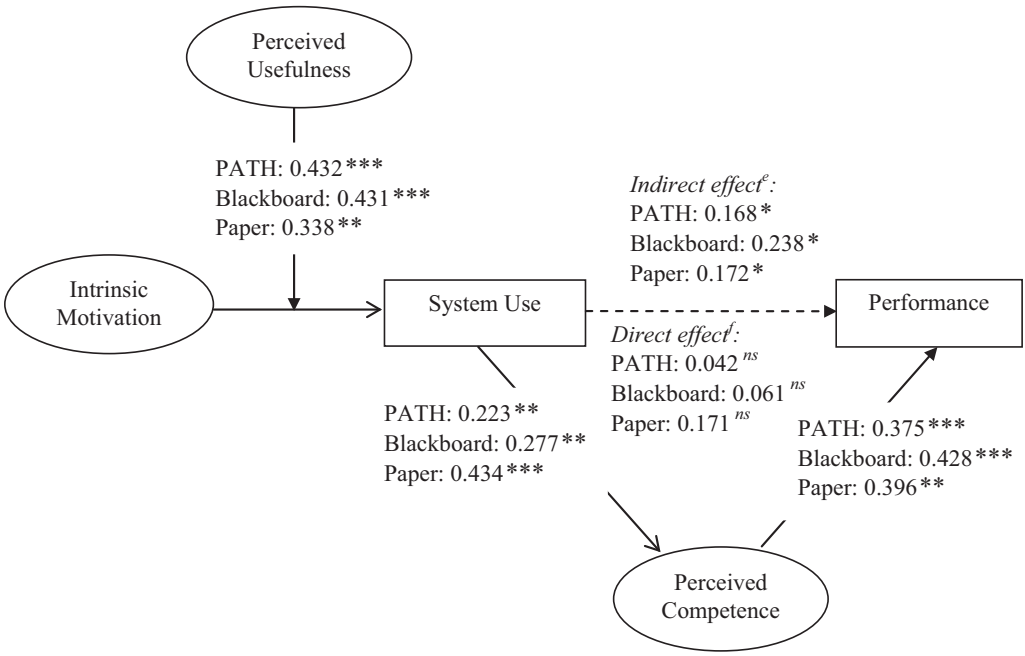


**Fig. 4.** Multiple-group model results. *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$, ns = not significant. [e]Indirect effect refers to the effect of system use on performance through perceived competence. [f]Direct effect refers to the effect of system use on performance.
Notes:
1. Since system type is a grouping variable, it is not shown as a separate variable in this figure.
2. Due to the sample sizes of 87, 46 and 40, respectively for PATH, Blackboard, and the traditional paper medium, the composite scores of intrinsic motivation, perceived usefulness, and perceived competence are used to increase the power of analysis.

Only hypotheses 2 and 3[11] were tested because system type was used as a grouping variable (i.e., system type could not be depicted as a separate variable) in the multiple group analysis. The model fit indices for the SEM three-group analysis satisfy the threshold requirements of a good model fit. As shown in Fig. 4, the results for hypotheses 2 and 3 are similar for PATH, Blackboard, and the traditional paper medium groups.

[11] Hypotheses 1a and 1b cannot be tested because the system type variable is used to split the data into three models to examine whether similar results are obtained for PATH, Blackboard, and the traditional paper medium groups.

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## 5. Discussion

### 5.1. Findings

We develop an educational computer program, PATH, which incorporates an instructional design with computer game features to enhance intrinsic motivation and performance in an accounting educational setting. These computer game features facilitate a positive learning experience by assisting students to master technical accounting materials. Specifically, participants engage in active interaction with the computerized tutorial, exercise control over receipt of feedback from the program, and learn at their own pace. We included Blackboard and the traditional paper medium as additional system types for comparison purposes. The results indicate that relative to Blackboard and the traditional paper medium users, PATH users exhibit the highest intrinsic motivation. Blackboard users also report higher intrinsic motivation than the traditional paper medium users. Further, the findings suggest that the high intrinsic motivation of PATH users increases their usage of PATH to complete the homework.

The results also show that when users perceive a system to be useful for attaining their goals (i.e., improved performance), this form of extrinsic motivation operates in concert with intrinsic motivation to increase system use. Lastly, the findings highlight the mediating effect of perceived competence to promote understanding of how system use improves performance.

### 5.2. Implications and contributions

The findings of this study have important implications for accounting education. Human–computer interaction research has recognized the important roles of enjoyment and fun in the design of user interfaces (Shneiderman, 2004). Indeed, the experience of flow is an important objective of user interface design. Interface designs that promote high quality human–computer interaction sustain the users' intrinsic motivation, leading to increased system use and improved performance. Thus, interest-enhancing features such as interesting computer animation, enhanced user–computer interaction, appealing interface design, and immediate system feedback can be incorporated into educational computer programs to enhance intrinsic motivation and performance in accounting education. Further, the findings demonstrate how an educational computer program, PATH, can be used to deliver technical accounting materials in a creative and motivation-enhancing manner to promote the students' intrinsic motivation and performance in the financial accounting course. This study sheds light on how effective strategies can be developed to assist students to learn technical accounting materials frequently perceived as boring and difficult.

Although this study demonstrates that the interest-enhancing features of PATH promote intrinsic motivation and performance, these features alone may not lead to positive performance effects because mere use of a system does not necessarily result in a positive learning effect. Appropriate instructional design and effective content delivery strategies are critical for enhancing intrinsic motivation and performance in accounting education. The findings of this study provide directions for the exploration of advantageous computer game features, which balance the extent of entertainment and the value of educational computer games in accounting education.

This study contributes to the extant literature on intrinsic motivation, system use, and performance. In an experimental setting, participants used PATH, Blackboard, or the traditional paper medium to complete homework, which enabled us to assess their intrinsic motivation associated with usage of their respective systems. This approach facilitates formation of meaningful inferences because PATH includes an instructional design that focuses on educational computer game for enhancing intrinsic motivation and performance.

The extant literature has investigated the positive impact of perceived usefulness on system use (Johnson et al., 2008; Saadé & Bahli, 2005). The present study extends previous research by examining perceived usefulness as a form of extrinsic motivation that interacts with intrinsic motivation to exert a positive impact on system use. This study illustrates a situation where extrinsic motivation does not undermine intrinsic motivation as a result of the positive information content inherent in the perceived usefulness construct which increases system use.

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The current study also builds on previous motivation research by examining perceived competence as a mediator, which explains the effect of system use on performance. The mediating effect of perceived competence provides insight into the inconsistent results reported in prior research on the impact of system use on performance. Finally, an important contribution of this study is the use of an objective outcome measure where performance is measured by each participant's total number of correct answers to the questions based on the content materials.

### 5.3. Limitations and suggestions for future research

As with any study, this study has limitations, which present opportunities for future research. One limitation is the use of the subjective usability measure: the participants' reported usage of their respective systems. Subjective usability measures pertain to a user's perception of or attitude toward an interface, interaction, or outcome. In contrast, objective measures are gathered, discussed, validated, and independent of user perception (Hornbaek, 2006). Future research can gather objective usability data such as computer recorded system usage to determine whether similar findings are obtained. Further, a common problem associated with experimental studies is the possibility that participants may be aware of the different systems used by other participants, despite efforts to control this possibility. This awareness may elicit certain emotional reactions and future work can increase understanding of this issue.

As the novelty of PATH decreases over a period of time, perceived usefulness increases with usage of this system. This contention is consistent with the users' inability to recognize the potential benefits of a system during the initial stage of usage; however, this effect is reversed during the later stage of usage (Karahanna, Straub, & Chervany, 1999). Future research can provide insight into this issue.

Games evoke a sense of personal control when users can select strategies, manage the direction of an activity, and make decisions that directly affect outcome, even if the actions are not instructionally relevant (Garris et al., 2002). Future research can examine whether increased intrinsic motivation ensues when students are given control over certain elements of the instructional program. Finally, future work can explore other attributes that can be included in educational computer games to promote learning of technical accounting materials.

## Appendix

*Performance assessment questions*

This questionnaire consists of 10 questions designed to assess your current level of accounting knowledge. If you do not know an answer, please do not guess and select option (e) I don't know.

1. Which of the following is a list of assets?
   a. Cash, Accounts Payable, and Sales Revenues
   b. Accounts Receivable, Sales Revenues, and Buildings
   c. Accounts Payable, Prepaid Insurance, and Cost of Goods Sold
   d. Cash, Accounts Receivable, and Prepaid Insurance
   e. I don't know
2. Which of the following is a true statement?
   a. Asset and Owners Equity accounts increase with a debit.
   b. Liability and Expense accounts increase with a debit.
   c. Revenue and Asset accounts increase with a debit.
   d. Expense and Asset accounts increase with a debit.
   e. I don't know
3. Which of the following is a true statement?
   a. Cash, Sales Revenue and Accounts Receivable are reported on the Balance Sheet.
   b. Prepaid Insurance and Unearned Revenue are reported on the Balance Sheet.
   c. Cash, Sales Revenue and Accounts Receivable are reported on the Income Statement.
   d. Prepaid Insurance and Unearned Revenue are reported on the Income Statement.

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e. I don't know

4. Analyze the effect this transaction has on the five account categories.

| | | |
|---|---|---|
| Building | 150,000 | |
| Cash | | 40,000 |
| Mortgage Payable | | 110,00 |

   a. Assets – increase; Liabilities – increase; Owners Equity – increase; Revenues – increase; Expenses – increase
   b. Assets – decrease; Liabilities – stay the same; Owners Equity – stay the same; Revenues – stay the same; Expenses – increase
   c. Assets – decrease; Liabilities – increase; Owners Equity – stay the same; Revenues – stay the same; Expenses – increase
   d. Assets – increase; Liabilities – increase; Owners Equity – stay the same; Revenues – stay the same; Expenses – stay the same
   e. I don't know
5. A twelve-month insurance policy was purchased on 01/01/06 for $2400. Which of the following is NOT true of the adjustment needed on 01/31/06?
   a. Expense needs to be recognized
   b. An accrual is needed
   c. An asset account is affected
   d. The adjustment is for $200
   e. I don't know
6. On a bank reconciliation, the amount of an unrecorded bank service charge should be:
   a. Added to the book balance of cash.
   b. Deducted from the book balance of cash.
   c. Added to the bank balance of cash.
   d. Deducted from the bank balance of cash.
   e. I don't know
7. A company had inventory on November 1st of 5 units at a cost of $20 each. On November 2nd, they purchased 10 units at $22 each. On November 3rd they purchased 6 units at $25 each. On November 12th, 8 units were sold for $55 each. Using the LIFO perpetual inventory method, what was the value of the inventory on November 12 after the sale?
   a. $304
   b. $296
   c. $288
   d. $276
   e. I don't know
8. A company purchased a $30,000 truck with an estimated three year or 100,000 mile life. There is no salvage value. Assume that the company has owed this truck for 2 full years and that it has been driven for 50,000 miles. What is the book value of this truck if the company uses the straight-line method of depreciation?
   a. $10,000
   b. $15,000
   c. $20,000
   d. $30,000
   e. I don't know
9. An investor wants to withdraw $8000 from an investment fund at the end of each year for 10 years. (The withdrawal includes principal.) How should the investor compute the required initial investment at the beginning of the first year if the fund earns 10% compounded annually?
   a. $8000 times the present value of $1 factor for 10 periods at 10%
   b. $8000 times the present value of an annuity factor for 10 periods at 10%
   c. $8000 times the future value of $1 factor for 10 periods at 10%
   d. $8000 times the future of an annuity factor for 10 periods at 10%
   e. I don't know

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10. Acme Company has 8000 shares of $5 par common stock and 3000 shares of $40 par, 5% non-cumulative preferred stock outstanding. No dividends were paid in the prior year. If the company declares cash dividends of $22,000 what is the total amount of the dividend paid to preferred shareholders?
    a. $22,000
    b. $12,000
    c. $6000
    d. $2000
    e. I don't know

## References


Aiken, L. S., & West, S. G. (1991). *Multiple regression: testing and interpreting interactions*. Thousand Oaks, CA: Sage.

Alliger, G. M., Tannenbaum, S. I., Bennett, W., Jr., Traver, H., & Shotland, A. (1997). A meta analysis of the relations among training criteria. *Personnel Psychology*, *50*, 341–358.

Amabile, T. M., DeJong, W., & Lepper, M. R. (1976). Effects of externally imposed deadlines on subsequent intrinsic motivation. *Journal of Personality and Social Psychology*, *34*, 92–98.

Arnold, H. (1985). Task performance, perceived competence, and attributed causes of performance as determinants of intrinsic motivation. *Academy of Management Journal*, *28*(4), 876–888.

Baker, R. E., & White, C. E. J. (1999). Internet uses in accounting education: survey results. *Journal of Accounting Education*, *17*, 255–266.

Baker, R. S. J. D., D'Mello, S. K., Rodrigo, M. M. T., & Graesser, A. C. (2010). Better to be frustrated than bored: the incidence, persistence, and impact of learners' cognitive–affective states during interactions with three different computer-based learning environments. *International Journal of Human-Computer Studies*, *68*, 223–241.

Baron, R. M., & Kenny, D. A. (1986). The moderator–mediator variable distinction in social psychological research: conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology*, *51*(6), 1173–1182.

Bickmore, T., Schulman, D., & Yin, L. (2010). Maintaining engagement in long-term interventions with relational agents. *Applied Artificial Intelligence : AAI*, *24*(6), 648–666.

Bickmore, T. W., & Picard, R. W. (2005). Establishing and maintaining long-term human–computer relationships. *ACM Transactions on Computer-Human Interaction : A Publication of the Association for Computing Machinery*, *12*(2), 293–327.

Browne, M. W., & Cudeck, R. (1993). Alternative ways of assessing model fit. In K. A. Bollen & J. S. Long (Eds.), *Testing structural equation models* (pp. 136–162). Newbury Park, CA: Sage.

Bryant, S. M., & Hunton, J. E. (2000). The use of technology in the delivery of instruction: implications for accounting educators and education researchers. *Issues in Accounting Education*, *15*(1), 129–162.

Burnham, K. P., & Anderson, D. R. (2004). Multimodel inference: understanding AIC and BIC in model selection. *Sociological Methods and Research*, *33*, 261–304.

Butler, R. J., Pray, T. F., & Strang, D. R. (1979). An extension of Wolfe's study of simulation game complexity. *Decision Sciences*, *10*, 480–485.

Cheng, E. W. L. (2001). SEM being more effective than multiple regression in parsimonious model testing for management development research. *Journal of Management Development*, *20*(7/8), 650–667.

Chin, W. W. (1998). The partial least squares approach to structural equation modeling. In G. A. Marcoulides (Ed.), *Modern business research method* (pp. 295–336). Mahwah, NJ: Lawrence Erlbaum Associates.

Cordova, D. I., & Lepper, M. R. (1996). Intrinsic motivation and the process of learning: beneficial effects of contextualization, personalization, and choice. *Journal of Educational Psychology*, *88*(4), 715–730.

Davis, D. F. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly : Management Information Systems*, *13*(3), 319–339.

Davis, F. D., Bagozzi, R. P., & Warshaw, P. R. (1992). Extrinsic and intrinsic motivation to use computers in workplace. *Journal of Applied Social Psychology*, *22*(14), 1111–1132.

De Freitas, S. (2006). *Learning in immersive worlds*. London: Joint Information Systems Committee.

Deci, E. L. (1972). Intrinsic motivation, extrinsic reinforcement, and inequity. *Journal of Personality and Social Psychology*, *22*, 113–120.

Deci, E. L., & Cascio, W. F. (1972). *Changes in intrinsic motivation as a function of negative feedback and threats*. Boston: Eastern Psychological Association.

Deci, E. L., Eghrari, H., Patrick, B. D., & Leone, D. R. (1994). Facilitating internalization: the self-determination theory perspective. *Journal of Personality*, *62*, 119–142.

Deci, E. L., & Ryan, R. M. (1980). The empirical exploration of intrinsic motivational processes. In L. Berkowitz (Ed.), *Advances in experimental social psychology* (Vol. 13, pp. 39–80). New York: Academic Press.

Deci, E. L., & Ryan, R. M. (1985a). *Intrinsic motivation and self-determination in human behavior*. New York: Plenum Press.

Deci, E. L., & Ryan, R. M. (1985b). The general causality orientations scale: self-determination in personality. *Journal of Research in Personality*, *19*, 109–134.

Deci, E. L., & Ryan, R. M. (2000). The "what" and "why" of goal pursuits: human needs and the self-determination of behavior. *Psychological Inquiry*, *11*(4), 227–268.

D'Mello, S., Olney, A., Williams, C., & Hays, P. (2012). Gaze tutor: a gaze-reactive intelligent tutoring system. *International Journal of Human-Computer Studies*, *70*, 377–398.

Doll, W. J., & Torkzadeh, G. (1998). Developing a multidimensional measure of system-use in an organizational context. *Information & Management*, *33*, 171–185.


Please cite this article in press as: Siew H. Chan, Qian Song, Laurie H. Rivera, Pailin Trongmateerut, Using an educational computer program to enhance student performance in financial accounting, J. of Acc. Ed. (2016), doi: 10.1016/j.jaccedu.2016.05.001

Edwards, J. R., & Bagozzi, R. P. (2000). On the nature and direction of relationships between constructs and measures. *Psychological Methods*, *5*(2), 155–174.
Elliot, A. J., & Church, M. A. (1997). A hierarchical model of approach and avoidance achievement motivation. *Journal of Personality and Social Psychology*, *72*, 218–232.
Elliot, A. J., & Harackiewicz, J. M. (1994). Goal setting, achievement orientation, and intrinsic motivation: a mediational analysis. *Journal of Personality and Social Psychology*, *66*(5), 968.
Fornell, C., & Larcker, D. F. (1981). Evaluating structural equation models with unobservable variables and measurement error. *Journal of Marketing Research*, *18*, 39–50.
Garris, R., Ahlers, R., & Driskell, J. E. (2002). Games, motivation, and learning: a research and practice model. *Simulation & Gaming*, *33*(4), 441–467.
Gelderman, M. (1998). The relation between user satisfaction, usage of information systems and performance. *Information & Management*, *34*(1), 11–18.
Goodhue, D. L., & Thompson, R. L. (1995). Task-technology fit and individual performance. *MIS Quarterly : Management Information Systems*, *19*(2), 213–226.
Hair, J. F., Anderson, R. E., Tatham, R. L., & Black, W. C. (1998). *Multivariate data analysis with readings*. Englewood Cliffs, NJ: Prentice Hall.
Harackiewicz, J. M., Manderlink, G., & Sansone, C. (1984). Rewarding pinball wizardry: effects of evaluation and cue value on intrinsic interest. *Journal of Personality and Social Psychology*, *47*(2), 287.
Harackiewicz, J. M., & Sansone, C. (1991). Goals and intrinsic motivation: you can get there from here. *Advances in Motivation and Achievement*, *7*, 21–49.
Hoffmann, L. (2009). Learning through games. *Communications of the ACM*, *52*(8), 21–22.
Holcomb, T., & Michaelsen, R. (1996). A strategic plan for educational technology in accounting. *Journal of Accounting Education*, *14*(3), 277–292.
Hornbaek, K. (2006). Current practice in measuring usability: challenging to usability studies and research. *International Journal of Human-Computer Studies*, *64*, 79–102.
Hornik, S., Johnson, R. D., & Wu, Y. (2007). When technology doesn't support learning: conflicts between epistemological beliefs and technology support in virtual learning environments. *Journal of Organizational and End User Computing: An Official Publication of the Information Resources Management Association*, *19*(2), 23–46.
Hou, C. K. (2012). Examining the effect of user satisfaction on system usage and individual performance with business intelligence systems: an empirical study of Taiwan's electronics industry. *International Journal of Information Management*, *32*, 560–573.
Hu, L., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: conventional criteria versus new alternatives. *Structural Equation Modeling : A Multidisciplinary Journal*, *6*, 1–55.
Humphrey, R. L., & Beard, D. F. (2014). Faculty perceptions of online homework software in accounting education. *Journal of Accounting Education*, *32*, 238–258.
Igbaria, M., & Tan, M. (1997). The consequences of information technology acceptance on subsequent individual performance. *Information & Management*, *32*(3), 113–121.
Jensen, R. E., & Sandlin, P. K. (1992a). How to do it? Getting started in authoring computer-aided teaching/instruction and what software features to consider. *Journal of Accounting Education*, *10*, 61–93.
Jensen, R. E., & Sandlin, P. K. (1992b). Why do it? Advantages and dangers of new waves of computer-aided teaching/instruction. *Journal of Accounting Education*, *10*, 39–60.
Jensen, R. E., & Sandlin, P. K. (1995). Who's doing it? Sources of public and private computer-aided learning materials for accounting educators. *Journal of Accounting Education*, *13*(2), 119–148.
Johnson, R. D., Hornik, S., & Salas, E. (2008). An empirical examination of factors contributing to the creation of successful e-learning environments. *International Journal of Human-Computer Studies*, *66*, 356–369.
Karahanna, E., Straub, D. W., & Chervany, N. L. (1999). Information technology adoption across time: across-sectional comparison of pre-adoption and post adoption beliefs. *MIS Quarterly : Management Information Systems*, *23*(2), 183–213.
Ke, W., Tan, C.-H., Sia, C.-L., & Wei, K.-K. (2012). Inducing intrinsic motivation to explore the enterprise system: the supremacy of organizational levers. *Journal of Management Information Systems*, *29*(3), 257–289.
Keller, J., & Bless, H. (2008). Flow and regulatory compatibility: an experimental approach to the flow model of intrinsic motivation. *Personality & Social Psychology Bulletin*, *34*, 196–209.
Kirriemuir, J., & McFarlane, A. (2003). Use of computer and video games in the classroom. In *The level up digital games research conference*. Netherlands: Universiteit Utrecht.
Kline, R. B. (2005). *Principles and practice of structural equation modeling*. New York: Guilford Press.
Knotts, U. S., & Keys, J. B. (1997). Teaching strategic management with a business game. *Simulation and Gaming*, *28*, 377–394.
Kong, J. S.-L., Kwok, R. C.-W., & Fang, Y. (2012). The effects of peer intrinsic and extrinsic motivation on MMOG game-based collaborative learning. *Information & Management*, *49*, 1–9.
Law, E. L. C., & Sun, X. (2012). Evaluating user experience of adaptive digital educational games with Activity Theory. *International Journal of Human-Computer Studies*, *70*(7), 478–497.
Lee, M. K. O., Cheung, C. M. K., & Chen, Z. (2005). Acceptance of Internet-based learning medium: the role of extrinsic and intrinsic motivation. *Information & Management*, *42*, 1095–1104.
Leemkuil, H., & de Jong, T. (2012). Adaptive advice in learning with a computer-based knowledge management simulation game. *Academy of Management Learning & Education*, *11*(4), 653–665.
Lepper, M. R., & Cordova, D. I. (1992). A desire to be taught: instructional consequences of intrinsic motivation. *Motivation and Emotion*, *16*(3), 187–208.
Lepper, M. R., Greene, D., & Nisbett, R. E. (1973). Undermining children's intrinsic interest with extrinsic reward: a test of the "overjustification" hypothesis. *Journal of Personality and Social Psychology*, *28*(1), 129–137.
Lindell, M. K., & Whitney, D. J. (2001). Accounting for common method variance in crosssectional research designs. *The Journal of Applied Psychology*, *86*(1), 114–121.
Locke, E. A., & Latham, G. P. (1990). *A theory of goal setting and task performance*. Hillsdale, NJ: Prentice Hall.

Please cite this article in press as: Siew H. Chan, Qian Song, Laurie H. Rivera, Pailin Trongmateerut, Using an educational computer program to enhance student performance in financial accounting, J. of Acc. Ed. (2016), doi: 10.1016/j.jaccedu.2016.05.001

Lucas, H. C., & Spitler, V. K. (1999). Technology use and performance: a field study of broker workstations. *Decision Sciences*, *30*(2), 291–311.
Mandryk, R. L., & Atkins, M. S. (2007). A fuzzy physiological approach for continuously modeling emotion during interaction with play environments. *International Journal of Human-Computer Studies*, *6*(4), 329–347.
Meece, J. L., Anderman, E. M., & Anderman, L. H. (2006). Classroom goal structure, student motivation, and academic achievement. *Annual Review of Psychology*, *57*, 487–503.
Miserandino, M. (1996). Children who do well in school: individual differences in perceived competence and autonomy in above-average children. *Journal of Educational Psychology*, *88*(2), 203–214.
Mossholder, K. W. (1980). Effects of externally mediated goal setting on intrinsic motivation: a laboratory experiment. *The Journal of Applied Psychology*, *65*, 202–210.
Murphy, E. A., & Hoeppner, C. J. (2002). Using technology and library resources in financial accounting courses. *Journal of Accounting Education*, *20*, 331–346.
O'Neil, H. F., Jr., Wainess, R., & Baker, E. L. (2005). Classification of learning outcomes: evidence from computer games literature. *The Curriculum Journal*, *16*(4), 455–474.
Pasin, F., & Giroux, H. (2011). The impact of a simulation game on operations management education. *Computers & Education*, *57*, 1240–1254.
Pentland, B. T. (1989). Use and productivity in personal computing: an empirical test. In *Tenth international conference on information systems* (pp. 211–222). Boston, MA.
Pilke, E. M. (2004). Flow experiences in information technology use. *International Journal of Human-Computer Studies*, *61*, 347–357.
Podsakoff, P. M., MacKenzie, S. B., Lee, J.-Y., & Podsakoff, N. P. (2003). Common method biases in behavioral research: a critical review of the literature and recommended remedies. *The Journal of Applied Psychology*, *88*(5), 879–903.
Prensky, M. (2007). *Digital game-based learning*. Paul, MN: Paragon House, St.
Rieber, L. P. (1991). Animation, incidental learning, and continuing motivation. *Journal of Educational Psychology*, *83*, 318–328.
Ross, M. (1975). Salience of reward and intrinsic motivation. *Journal of Personality and Social Psychology*, *32*, 245–254.
Ryan, R. M., Connell, J. P., & Plant, R. W. (1990). Emotions in non-directed text learning. *Learning and Individual Differences*, *2*, 1–17.
Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *The American Psychologist*, *55*, 68–78.
Ryan, R. M., Koestner, R., & Deci, E. L. (1991). Ego-involved persistence: when free-choice behavior is not intrinsically motivated. *Motivation and Emotion*, *15*, 185–205.
Ryan, R. M., Mims, V., & Koestner, R. (1983). Relation of reward contingency and interpersonal context to intrinsic motivation: a review and test using cognitive evaluation theory. *Journal of Personality and Social Psychology*, *45*, 736–750.
Saadé, R., & Bahli, B. (2005). The impact of cognitive absorption on perceived usefulness and perceived ease of use in on-line learning: an extension of the technology acceptance model. *Information & Management*, *42*, 317–327.
Segars, A. H., & Grover, V. (1993). Re-examining perceived ease of use and usefulness: a confirmatory factor analysis. *MIS Quarterly : Management Information Systems*, *17*, 517–525.
Self determination theory. (2016). <http://selfdeterminationtheory.org/intrinsic-motivation-inventory/> Accessed 05.06.16.
Shneiderman, B. (2004). Designing for fun: how can we design user interfaces to be more fun? *ACM Interactions*, *11*(5), 48–50.
Smith, W. E. (1974). *The effects of social and monetary rewards on intrinsic motivation* (Unpublished doctoral dissertation). In C. University (Ed.).
Steiger, J. H. (1990). Structural model evaluation and modification: an internal estimation approach. *Multivariate Behavioral Research*, *25*, 173–180.
Steiger, J. H., & Lind, J. C. (1980). *Statistically based tests for the number of common factors*. Iowa City, IA: Proceedings of the annual meeting of the Psychology Society.
Subramanian, G. H. (1994). A replication of perceived usefulness and perceived ease of use measurement. *Decision Sciences*, *25*(5/6), 863–873.
Svingby, G. (2010). Feedback in educational computer games. In *European conference on games based learning*.
Szajna, B. (1993). Determining information systems usage: some issues and examples. *Information & Management*, *25*(3), 147–154.
Szajna, B. (1994). Software evaluation and choice: predictive evaluation of the Technology Acceptance Instrument. *MIS Quarterly : Management Information Systems*, *18*(3), 319–324.
von Ahn, L., & Dabbish, L. (2008). Designing games with a purpose. *Communications of the ACM*, *51*(8), 58–67.
Vandercruysse, S., Vandewaetere, M., & Clarebout, G. (2012). Game-based learning: a review on the effectiveness of educational games. In *Handbook of research on serious games as educational, business, and research tools* (pp. 628–647). Hershey, PA: IGI Global.
Venkatesh, V. (1999). Creation of favorable user perceptions: exploring the role of intrinsic motivation. *MIS Quarterly : Management Information Systems*, *23*(2), 239–260.
Venkatesh, V. (2000). Determinants of perceived ease of use: integrating perceived behavioral control, computer anxiety and enjoyment into the technology acceptance model. *Information Systems Research*, *11*, 342–365.
Venkatesh, V., & Speier, C. (1999). Computer technology training in the workplace: a longitudinal investigation of the effect of mood. *Organizational Behavior and Human Decision Processes*, *79*, 1–28.
Venkatesh, V., & Speier, C. (2000). Creating an effective training environment for enhancing telework. *International Journal of Human-Computer Studies*, *52*, 991–1005.
Wang, C.-C., & Hsu, M.-C. (2014). An exploratory study using inexpensive electroencephalography (EEG) to understand flow experience in computer-based instruction. *Information & Management*, *51*(7), 912–923.
Weston, R., & Gore, P. A. (2006). A brief guide to structural equation modeling. *The Counseling Psychologist*, 719–751.
Wilson, K. A., Bedwell, W. L., Lazzara, E. H., Salas, E., Burke, C. S., Estock, J. L., et al. (2009). Relationship between game attributes and learning outcomes: review and research proposals. *Simulation & Gaming*, *40*(2), 217–266.
Wolf, G. (1972). Some research and teaching with an on-line oligopoly game using an artificial player. *Decision Sciences*, *3*, 101–114.

Please cite this article in press as: Siew H. Chan, Qian Song, Laurie H. Rivera, Pailin Trongmateerut, Using an educational computer program to enhance student performance in financial accounting, J. of Acc. Ed. (2016), doi: 10.1016/j.jaccedu.2016.05.001

Wouters, P., van der Spek, E. D., & Van Oostendorp, H. (2009). Current practices in serious game research: a review from a learning outcomes perspective. In *Games-based learning advancements for multisensory human computer interfaces: techniques and effective practices* (pp. 232–255).

Wu, W. H., Hsiao, H. C., Wu, P. L., Lin, C. H., & Huang, S. H. (2012). Investigating the learning theory foundations of game-based learning: a meta-analysis. *Journal of Computer Assisted Learning*, *28*, 265–279.

Yi, M. Y., & Hwang, Y. (2003). Predicting the use of web-based information systems: self-efficacy, enjoyment, learning goal orientation, and the technology acceptance model. *International Journal of Human-Computer Studies*, *59*(4), 431–449.

Please cite this article in press as: Siew H. Chan, Qian Song, Laurie H. Rivera, Pailin Trongmateerut, Using an educational computer program to enhance student performance in financial accounting, J. of Acc. Ed. (2016), doi: 10.1016/j.jaccedu.2016.05.001