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Really Engaging Accounting: Second Life™ as a Learning Platform

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ABSTRACT: Immersive virtual worlds such as Second Life™ promise the possibility of an engaging platform for learning. This paper examines the success of Second Life™ in enabling an engaging learning environment within a first-year financial accounting course, specifically the relationship between student engagement and performance. The paper details the use of two 3-D objects built to support the course, an interactive accounting equation, and t-account model. Results indicate that student engagement, as enabled via Second Life™ may lead to greater student performance. However, results also indicate a reduction in performance if students have adverse (dizziness, nausea) reactions to the environment.

INTRODUCTION

The purpose of this paper is to examine the relationship between level of engagement, as perceived by students after their use of the Second Life™ platform, and performance as determined by exam scores. Immersive virtual worlds such as Second Life™ promise the possibility of an engaging platform for learning. Second Life™ is being investigated as a learning platform in content areas such as computer programming (Esteves et al. 2009), operations management (Lee 2009), entrepreneurship, technology and e-commerce (Mennecke et al. 2008). This paper examines the effect that Second Life™ may have on the relationship between student engagement and performance in an accounting setting.

The first-year financial accounting course has many unique characteristics associated with it relative to other core courses that undergraduate students take in their early academic pursuits. Specific complexities awaiting these students can be associated with course content, course need—a large percentage of the students are compelled to take the course to fulfill a core requirement (usually but not limited to business students)—new language acquisition, and the application of that language. Unlike most other courses at the introductory level, all of these skills need to be learned simultaneously, that is language skills and the application of that language. And unlike many courses at this level, failing to grasp a good understanding of the foundational concepts at the start of a semester is extremely hard to overcome as the semester progresses. These challenges are evidenced in low retention and high failure rates.

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Student engagement could mitigate these problems. Student engagement has been associated with important learning outcomes including performance, satisfaction, and retention, (Chen et al. 2008) and technology has often been seen as a possible tool to improve student engagement (Lightner et al. 2007). One promising learning platform, Second Life™, a user created immersive 3-D environment, provides compelling opportunities for creating an engaging learning environment. While virtual worlds hold out great promise, little empirical research has been conducted to evaluate if the tantalizing promise of student engagement can be supported. Thus, this paper intends to discuss how Second Life™ has been used in an introductory financial accounting course and empirically examines the relationship between student engagement and student performance after using the Second Life™ environment.

ENGAGEMENT

The need for greater student engagement is an important variable in higher education. In a recent publication (Salanova et al. 2009) engagement was found to predict student performance as well as mediate the impact of learning obstacles and facilitators. Engagement can be viewed as "the amount of physical and psychological energy that the student devotes to the academic experience" (Astin 1984), as well as the degree to which students value their learning activity (McInnis et al. 2000). Thus engagement can be seen as a student's interest in and involvement with the learning task (Lessiter et al. 2001). Student engagement is associated with increased time on task and the development of deep learning, resulting in better classroom performance. Following (Fredricks et al. 2004; Johnson, 2008b), this paper situates engagement as more than just student motivation, but rather an antecedent to the concept of flow (Csikszentmihalyi 1990); thus, engagement is conceptualized as a combination of concentration, interest, and enjoyment and treats engagement as a continuum anchored by disengaged and engaged (Bryson and Hand 2007).

While engagement has been studied at different levels—spanning the university to a single classroom—Bryson and Hand (2007) argue that engagement can be viewed as a continuum from disengaged to engaged, and at different levels:

- Toward the classroom, task or assignment;
- Toward a particular module;
- Toward a program of study; or
- Toward the university or higher education.

Thus, when examining the impact of a learning tool or platform on student engagement it is important to denote the level at which the analysis will take place.

Some might argue that learning the language of business and applying that language can be less than engaging (i.e. enjoyable). However, as recently suggested (Johnson 2008b), lack of engagement may not be a student problem but an instructor or instructional design problem. If so, then techniques implemented to increase a student's engagement with the material may lead to greater performance. However, very few studies have investigated the impact of engagement on accounting students' performance. Hall et al. (2004) found that changes in the course environment can lead to changes in the learning approaches taken by students. Carnaghan and Webb (2007) found that by using group response systems (classroom clickers), students felt more engaged and actively participated more in class. No studies found by the authors have empirically examined Second Life™ and engagement.

STUDENT LEARNING IMPEDIMENTS

While it is hoped that this new learning platform will create positive learning experiences for our students, we must keep in mind that our desire to use new cutting edge technologies may not always be perceived as beneficial by our students. As instructors we may expect that if students are more engaged with course content, this could lead to greater student performance. However, some students may choose not to be engaged, may choose not to use the technologies we develop, or may have problems becoming engaged or using the technologies due to an incongruence between the course technology and their epistemological beliefs (Hornik et al. 2007). Additionally, as newer technology with 3-D immersiveness is utilized, we need to examine some of the adverse affects that this technology might have on students. For example, some can feel dizzy or nauseous in these environments. Together, incongruence and adverse affects of using the technology can lead to disengaged students and poorer performance.

This study examines Second Life™, a 3-D virtual world, to create an engaging environment in which to teach and learn financial accounting. The remainder of the paper will first describe Second Life™ and discuss how certain affordances enabled through Second Life™ can stimulate student interest, concentration, and enjoyment in completing tasks. This will be followed by details on the use of Second Life™ in an introductory accounting course, hypotheses development, and a discussion of the research methodology employed. Lastly, the results of the study, discussion of those results, and limitations of the study will be discussed.

SECOND LIFE™

Second Life™ is a 3-D Multi-User Virtual Environment (MUVE) created by Linden Laboratories. Second Life™ is not a game as it does not have any specific goals or objectives. To use Second Life™ you first need to sign up for an avatar. To create an avatar you select from a list of last names and then create any first name and the type of avatar (male, female) you wish to use. An avatar is your virtual representation or presence within Second Life™ and the means by which you will communicate and interact with other avatars and objects. Figure 1 is a representation of an avatar, named Robins Hermano.[1]

Once you have an account—you download the Second Life™ client (or viewer) which is what is used to connect to the virtual world. Users of Second Life™ are known as residents and being inside Second Life™ is referred to as being in-world. Second Life™ content is created and owned by users who retain intellectual property rights to the content. The content creation tools are

FIGURE 1
Avatar of the First Author

[1] This is the avatar of the first author.

integrated into the Second Life™ viewer, which is one of the differentiating factors between Second Life™ and other virtual platforms (e.g. Croquet, Sun's Wonderland, Forterra). The materials required to build objects are provided free and are infinitely available but are constrained by the amount of land (or server space) you own. In addition to ownership rights, Second Life™ has a currency, the Linden Dollar which trades at approximately $250L to $1. Lindens are used for buying and selling content created by residents as well as for buying or renting land. There is some limited exchange rate speculation that occurs as well. Second Life™ uses a land metaphor for the server space that is used to render the 3-D content. As a MUVE without any specific goals but with content creation tools, Second Life™ has become home to many diverse interests with education as an active, vocal, creative, collaborative part. In October of 2006, one estimate of the number of educational islands was around 30 (Dudeney 2006) and has grown to well over 1,200 educational islands (Johnson 2008a) today. There are also many more higher education institutions with a presence smaller then an island in Second Life™.

While Second Life™ features allow for traditional delivery of course content such as class slides and voice lectures, as an educational platform it can also be approached as a new way to foster collaboration, creativity, and creation of content. By allowing residents the freedom to develop anything that can be imagined, the skilled educator can bring to life concepts that are difficult for students to visualize. This content can be replicas such as the Sistine Chapel, part of Vassar College ("Vassar College") or a Saturn V rocket developed by the International Space Flight Museum ("International Space Flight Museum"), or a 3-D representation of abstract concepts—such as debits or credits (Really Engaging Accounting).

The Second Life™ platform enables your avatar to walk, fly, and move around the various objects built by residents. Second Life™'s ability to create the feeling of immersion within an environment coupled with the capabilities inherent in the client for building and scripting objects has the potential to capture students' interest and foster student engagement in course content. It is this potential that may lead to gains in learning outcomes if students become engaged not just with the Second Life™ environment, but with the learning objects that the students interact with. The following section describes the learning objects used as part of a first-year financial accounting course.

Second Life™ for Financial Accounting: Classroom Environment Tools

The classroom used in this study in Second Life™ is part of the New Media Consortiums archipelago of islands. The island is named Teaching 4, and the plot is named Really Engaging Accounting. The classroom in Really Engaging Accounting had the following learning areas: lecture viewing areas, study group areas including student accessible message boards, instructor office space with message board, calendar of due dates, and pager. The lecture viewing areas were set up so that students in-world could watch video lectures of the course material. Lectures[2] are streamed into Second Life™ and student avatars are able to choose from any lecture in any chapter. Additionally, students are able to view short reviews prior to an exam. There are three separate areas where students can watch videos so that different groups can be viewing different videos at the same time. The use of in-world viewing is intended to foster a sense of community, social presence, and engagement with the course material. It is intended to allow students to watch a lecture, discuss, ask questions, and receive answers about the content. Student choices of viewing lectures outside of Second Life™ included WebCT and an external website (http://mydebitcredit.com). The outlet used most frequently was WebCT (70 percent), followed by view-

[2] Lectures were created using Camtasia Studio and output as .m4v files capable of streaming and viewing with QuickTime, the video viewer used by Second Life™.

ing in Second Life™ (13 percent). A study group area was created that included a white-board in which students could write limited questions, answers, journal entries, and equations. To foster the use of Second Life™ as an extension of the classroom/instructor office, a calendar was implemented which contained information related to due dates for homework assignments as well as exam dates. The office area also had a pager which notified students if the instructor was in-world but not in the class area. See Figure 2, for an example of the student study area on Really Engaging Accounting.

While the above content was created to foster a sense of place for the students in this new environment, the heart of the class was the use of the interactive accounting equation model (basic and expanded) and an interactive T-account model. Students interacted with the accounting models via text chat or through the use of notecards. While in their current form, the models are set up for one-to-one interaction, groups of students can, and did, participate.

Second Life™ for Financial Accounting: Interactive Accounting Equation

One of the foundational concepts in financial accounting is the accounting equation (Assets = Liabilities + Stockholders Equity) and how the elements of the equation are impacted by business transactions which either increase or decrease the values in the equation. It is the accounting equation coupled with new vocabulary used to manipulate the equation (debit and credit) that is the underpinning of the accounting system. Students sometimes have great difficulty in applying the language of accounting, specifically in the case of the accounting equation. To help students understand the equation and how debits and credits affect the different components of the equation, a model of the equation was built. The model contained separate 3-D cubes representing assets, liabilities, and stockholders' equity (for the basic model), and, additionally, revenues and expenses (for the expanded model). Each cube was shaded a different color and the liability and equity cubes were linked so that students could visualize their relationship to the total size of the assets cube. In addition to the 3-D cubes, the equation was also displayed and updated in real time as transactions were entered into the model. Students would interact with the model by "talking"

FIGURE 2
Student Study Area

with the model via chat using the same interface they use to talk with other avatars. Figure 3 shows the accounting equation with feedback provided as an avatar is interacting with it.

Each cube was scripted to listen to a specific text chat channel and the channels selected were based on the chart of account model where assets listened for transactions on channel 100, liabilities on channel 200, equity on channel 300, revenue on channel 400, and expenses on channel 500. For a typical business transaction involving one debit and one credit, students were required to "say" each part of the transaction individually, thus chatting with the model twice. The students could also write a transaction(s) on a notecard (a text file used in Second Life™) and drag the notecard onto the model which would then process the entire transaction. Figure 4 shows an example of a notecard used by students for completing assignments.

The model allowed students to visualize how a debit or credit would increase or decrease one of the account types and the impact on the accounting equation. As students interacted with the model they would continuously receive feedback from the model (in the form of text chat) indicating what a particular debit or credit transaction was doing and whether a particular transaction was balanced. See Figure 5 for an example of students using the interactive accounting equation.

FIGURE 3
Accounting Equation Feedback

FIGURE 4
Student Notecard

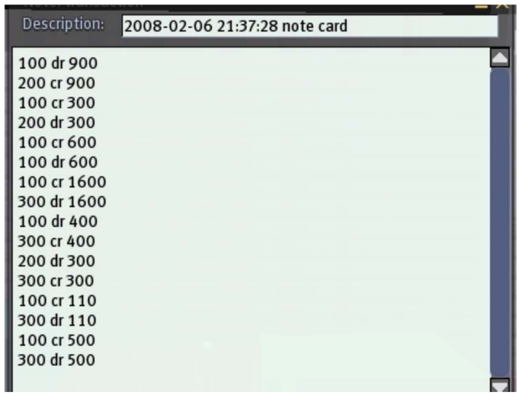
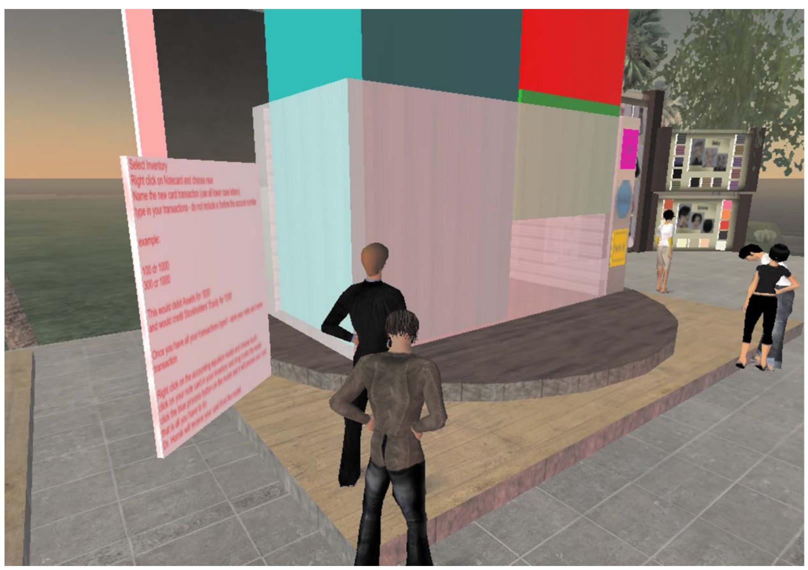


FIGURE 5
3-D Interactive Accounting Equation (Basic Model)



Second Life™ for Financial Accounting: Interactive T-Account

The interactive 3-D T-account (see Figure 6) allowed students to work on the use of t-accounts by having their avatars become a debit or credit and actually walking onto a t-account. The concept is to have the students become pieces in an accounting game. This enabled students to practice their understanding of the concept of normal account balances. The model would provide students with random accounts along with a description of whether the account was

FIGURE 6
Interactive T-Account

increasing or decreasing. Upon receiving this information the student would become a debit or credit—facilitated via a cube attached to their heads—and step on the correct side of the t-account to reflect the proper accounting treatment for the account. Students would receive feedback from the model (in the form of text chat and flashing color—green for correct, red for incorrect) indicating if they were positioned on the t-account correctly and of the proper type, debit or credit. If they were not, the model would provide feedback on the error (they were on the wrong side or they were the wrong type for the side they were on) and the students could make the correction and ask for feedback from the model again.

HYPOTHESIS DEVELOPMENT

In the traditional accounting course students are required to learn content via text and lectures. With respect to the accounting equation this involves several steps which need to be integrated within the learner. In a traditional course this can mean applying that content by doing repetitive exercises (with feedback coming after the fact, when it is graded). Because the accounting equation is an intangible—it cannot be touched, manipulated, or played with, vocabulary has to be learned without context. That is, debit simply means left side, but how that affects an account is one step removed from the definition. It is therefore necessary for students to integrate the equation with the new language into a working system within their minds and as this occurs performance in class is positively affected.

Alternatively, using Second Life™ students can touch, talk to, receive feedback from, and even "play" with the interactive accounting model. Students are able to become a debit or credit while playing with the interactive T-account. These interactive models and tools are expected to create interest, concentration, and enjoyment with the task of learning an equation and vocabulary. In other words the ability to create interactive 3-D objects, which have the capability to provide interactive feedback with an avatar in a social environment, is expected to be enough of a change in the course environment (Hall et al. 2004) that student engagement is expected to increase. Second Life™, used as an educational platform, may be gaining in adherents, but it is still a very recent development. Therefore, this study is conducted as an exploratory analysis to determine if the use of this platform in a financial accounting course can enable student engagement, and, if so, translate into greater student performance. Given prior studies have shown a relationship between student engagement and student performance (Chen et al. 2008; Salanova et al. 2009), we hypothesize that:

H1: Student engagement from working with Second Life™ will be positively associated with student performance.

H2: Student engagement will lead to increased time on task.

Though it is expected that the use of Second Life™ in general and the accounting learning objects in particular will foster student engagement, some students can have adverse psychological effects to immersive 3-D environments. Feelings of nausea, dizziness, eyestrain, etc. have been noted in virtual environments (Bailenson et al. 2006; Fornells-Ambrojo et al. 2008). It can be expected that any benefits gained from the use of this learning platform will be overshadowed if students experience such adverse reactions. Thus, we hypothesize:

H3: Students who feel adverse effects from the use of Second Life™ will have lower performance outcomes.

METHODOLOGY

Research Setting

The research was conducted with students enrolled in a first-year financial accounting course. The course is taught as a hybrid course with reduced class seat time. To accommodate the reduction in class time, all course lectures were provided online. Face-to-face class time was spent covering various exercises and problems from the textbook. The course met one evening per week. The enrollment for the course in the spring '08 semester was 169 to start, with 124 finishing the course. The course is taught as a traditional financial accounting course based on the accounting equation, debits and credits, and a focus on the accounting of common items that appear on the balance sheet and income statement, as well as a discussion of the cash flow statement. The course had four exams which covered from two to three chapters each and a cumulative final exam. In addition to the exam, students were required to do one textbook exercise per chapter, one concept map per chapter, and a total of four Second Life™ assignments. For the interactive accounting equation assignments, students would type a transaction onto notecards and drop them on the model. The model would process the transaction and send an email to the instructors' account with the completed transaction in CSV format for later grading.

For the interactive T-Account game, students were required to work with the model and get a specific number of transactions correct within a pre-defined amount of time (15 correct within five minutes). Again, when students completed the assignment the results (number of correct responses and time on task) were sent to the instructors account via email. After completing the Second Life™ assignments the students were asked to fill out an online survey for course extra credit.

Measures

The research instrument used for this study was the ITC-Sense of Presence survey (Lessiter et al. 2001). The instrument is intended to be used in any immersive environment and thus is agnostic to the platform. The instrument measures *spatial presence*, *engagement*, *ecological validity*, and *negative effects* (hereafter referred to as adverse reactions). The survey contains 40 questions and uses a 5-point strongly agree to strongly disagree response format for all questions.

Engagement was measured using a 13-question scale; the coefficient alpha reliability estimate for this scale was 0.935. An example of some of the engagement questions were, "I felt involved in Second Life™," "I enjoyed myself," and "My experience was intense." It is important to note that the survey questions are not asking if the students were generally engaged with accounting or the class (which would be closely related to the concept of student motivation), but instead focused the students perceptions of engagement as a consequence of using the Second Life™ platform.

Adverse reactions was measured using a 6-question scale; the coefficient alpha reliability for this scale was 0.852. An example of some of the adverse effects questions were, "I felt dizzy," "I felt nauseous," "I had a headache," and "I had eyestrain."

Additional data was collected to control for other factors that could potentially explain the relationship between *Exam1* score and *Engagement*. These included *Internet* skill (measured using a single five-point Likert item anchored with *Proficient/Developer* on the high end and *Novice* on the low end), *Age*, and *GPA*. Finally, the type of student performance assessed in this study was declarative knowledge. *Declarative knowledge* was assessed using student scores from the first exam. The survey was given to the students at the beginning of the second exam and concluded at the end of the second exam. We chose to examine only the results from the first exam in our analysis because the student required interaction with Second Life™ occurred primarily during the first part of the course prior to the first exam.

Research Participants

A total of 110 students participated in the study.[3] Four cases were excluded from the analysis for missing data, leaving a final sample of 106 subjects. The sample consisted of 60 males and 50 females. The average age was 23.9 (SD = 5.8), with a range of 19–51. Ninety-five percent of the respondents had Second Life™ installed on their computer with the remaining using Second Life™ on the campus laboratory computers and 70.8 percent indicated they were expert or advanced in Internet skills. A correlation conducted examining these control variables with engagement found Internet skills to have a significant positive relationship with engagement and thus is included in our model as a control variable. In addition to Internet skills, data was also gathered to assess the relationship of age and ability (assessed via self-reported GPA) to engagement, neither of which was found to be significantly related to engagement. However, both are included in our model as control variables. See Table 1 for the correlations of the research variables.

RESULTS

Linear regression analysis (see Table 2) was used to determine the relationship between engagement and *Exam1* score. Linear regression analysis using ordinary least-squares (OLS) indicated a significant and positive association between engagement and performance on *Exam1*, given during the period of the Second Life™ exercise. The model fit was significant at the 1 percent level (F = 4.148) with an adjusted R^2 of 10.7 percent. Control variables for *Age* and *GPA*

[3] Approval from the first author Institutional Review Board was granted to use human subjects.

TABLE 1
Pearson Correlations

Variable	*Exam1*	*Adverse Effect*	*Internet*	*GPA*	*Age*
Exam1	1.000				
Adverse Effect	−.245***	1.000			
Internet	−.153*	−.225***	1.000		
GPA	.194**	.007	.122	1.000	
Age	.261***	−.066	−.128*	.106	1.000

***, **, * Significance at 1 percent, 5 percent, and 10 percent levels, respectively (one-tailed).

TABLE 2
OLS Regression Model

$$Exam1 = \beta_0 + \beta_1 Engagement + \beta_2 Internet + \beta_3 GPA + \beta_4 Age + \varepsilon.$$

Variable	Coefficients	Standard Error	t-statistic	Significance (one-tailed)
(Constant)	53.821	8.617	6.246	.000
Engagement	2.359	1.401	1.683	0.048
Internet	−2.372	1.305	−1.817	0.036
GPA	4.481	2.330	1.923	0.023
Age	.430	.197	2.189	0.016

n = 106.
F = 4.148 (.004).
Adj. R^2 = .107.

were also significant and positively associated with exam performance, while the coefficient for Internet experience was significant and negative. Thus, H1 is supported.

To test H2, we analyzed the time that the students spent using the t-account model. The assignment involving the t-account required students to get 15 corrects responses within a five-minute time-frame. If student engagement leads to greater time on task, then it is expected that engaged students will spend more than five minutes on this task. Since students could have stopped using the t-account after five minutes, any time spent beyond that may be an indication of their engagement. While some students may have spent more then five minutes because of difficulty getting 15 correct responses or learning how to use the t-account, an examination of the results used in this study showed this was not the case. Table 3 shows the mean and standard deviation for time on task (in minutes).

A t-test was conducted to determine if time-on-task was significantly greater than the five-minute requirement. The results are reported in Table 4 indicate, students spent a significantly greater time on the interactive t-account than the required five minutes. Thus, H2 is supported.

While the above results indicate that Second Life™ as a learning tool can have positive outcomes with respect to student performance, it is still important to examine how being adversely

TABLE 3
Mean and Standard Deviation for Time on Task

	n	Mean	Min.	Max.	Std. Deviation
Time on Task (in minutes)	49	30.867	0.77	104.83	24.752

TABLE 4
Results of t-test

	t	df	Significance (two-tailed)
Task/Minutes	7.315	48	.000

Test value = 5 minutes.

affected might impact student performance. As with engagement, we examined the relationship between adverse feelings from the use of Second Life™ and student performance. Table 1 shows the correlations of the model variables and Table 5 contains the result of the linear regression.

Linear regression analysis using ordinary least-squares indicated a significant and negative association between adverse effects and performance on *Exam1*, given during the period of the Second Life™ exercise. The model fit was significant at the 1 percent level (F = 6.002) with an adjusted R^2 of 16.0 percent. Control variables for *Age* and *GPA* remain significant and positively associated with exam performance, while the coefficient for *Internet* experience was significant and negative. Thus, H3 is supported.

TABLE 5
OLS Regression Model (Adverse Effects)

$$Exam1 = \beta_0 + \beta_1 Adverse\ Effects + \beta_2 Internet + \beta_3 GPA + \beta_4 Age + \varepsilon.$$

Variable	Coefficient	Standard Error	t-test	Significance (one-tailed)
(Constant)	71.428	9.027	7.913	0.000
Adverse Effects	−4.977	1.625	−3.063	0.000
Internet	−2.981	1.289	−2.313	0.012
GPA	5.017	2.259	2.221	0.015
Age	.402	.191	2.109	0.019

n = 106.
F = 6.002 (.000).
Adj. R^2 = .160.

ADDITIONAL FINDINGS

Though not hypothesized, we wondered if there was any relationship between adverse effects—for example, feelings of dizziness or eye strain on time on task—and so we conducted a *post hoc* analysis on time on task to see if adverse effects would also have an impact on that measure, allowing us to possibly put forward an explanation of why adverse effects had such a negative effect on the first exam outcome. Table 6 shows the results of these tests. The first model indicates that the greater the adverse feelings the subjects had the less time they spent on the t-account task. The second model indicates that females had increased the time on task more so than did the males. Model 3 indicates that time on task appears to be partially mediated by gender. That is, both adverse feelings and gender were associated with time on task, but when the interaction term was included, the main effect for adverse effects became insignificant. That is, to the extent all students experienced adverse effects they reduced time on task, but the adverse effects were more pronounced for females than for males (if they had a bad experience, they quit earlier than males).

As the findings from this study indicate, the more a first-year accounting student is engaged with course content facilitated by the Second Life™ platform and the 3-D accounting equation, the better they performed, future research should begin to investigate ways in which the environment can reach more students. One area that may prove relevant in this regard is the concept known as social presence.

It can be inferred that for students to be engaged with course content they will need to feel as if they are immersed in it, as well as feel connected to other students and the instructor. Social presence is a measure of the perceived connectedness between students, students and instructor, students and content. Social presence was first described and defined by (Short et al. 1976, 65) as "the degree of salience of the other person in the interaction and the consequent salience of the interpersonal relationships." Since then, the concept of social presence has been debated to be a

TABLE 6

OlS Model of Time on Task and Adverse Effects

$$\textit{Time on Task} = \beta_0 + \beta_1 \textit{Adverse Effects} + \beta_2 \textit{Gender} + \beta_3 \textit{Adverse} \times \textit{Gender}.$$

F	Sig.	Adjusted R^2		B	Std. Error	t	Sig.
5.42	.024	0.086	(Constant)	61.341	13.405	4.576	.000
			Adverse Effects	−15.627	6.711	−2.328	.024
6.08	.005	0.178	(Constant)	58.124	12.782	4.547	.000
			Adverse Effects	−17.366	6.405	−2.711	.009
			Gender Code	16.608	6.711	2.475	.017
5.84	.002	0.236	(Constant)	38.053	15.579	2.443	.019
			Adverse Effects	−6.719	7.981	−.842	.404
			Gender Code	68.407	25.442	2.689	.010
			Adverse × Gender	−26.511	12.594	−2.105	.041

Dependent Variable: Task/Minutes.
n = 48

function of the media (Daft and Lengel 1986), as a socially constructed construct (Burke and Chidambaram 1999; Carlson and Gordon 1998), and as a psychological connection between learners (Tu 2002). Within virtual spaces like Second Life™, the concept of social presence should perhaps synthesize these two views as a learner perception of the extent to which the technology enables them to create an environment in which they feel is warm, personal, sociable, and active, and allows them to be connected in a shared learning space (Biocca et al. 2003; Johnson et al. 2008).

We believe that for students to increase engagement in these 3-D virtual environments they must first feel psychologically connected with others and with the content in the environment. That is, there must be a sense of being in the shared learning space and there needs to be a minimum amount of familiarity with the environment (ecological validity). To examine this conjecture we created a simple regression model using social presence and ecological validity to predict student perceptions of engagement.[4] We also included the adverse reactions construct, expecting that such a reaction by students would counteract any perceptions of engagement. The results of the regression are shown in Table 7. As the results indicate only spatial presence was useful in predicting student perceptions of engagement. It seems that a necessary condition for engagement in these new virtual environments is the need for students to have a sense of actually being a part of and immersed in the created content.

TABLE 7
Test of Between Subjects

$$Engagement = \beta_0 + \beta_1 Spatial\ Presence + \beta_2 Ecological\ Validity + \beta_3 Adverse\ Effects + \beta_4 Gender + \beta_5 Spatial \times Gender.$$

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	73.185[a]	96	.762	4.239	.003
Intercept	70.821	1	70.821	393.797	.000
Spatial Presence	10.711	28	.383	2.127	.076
Ecological Validity	3.501	15	.233	1.298	.322
Adverse Effects	3.141	16	.196	1.091	.443
Gender	.190	1	.190	1.058	.322
Spatial × Gender	3.470	18	.193	1.072	.458
Error	2.338	13	.180		
Total	931.473	110			
Corrected Total	75.523	109			

[a] R^2 = .969, (Adjusted R^2 = .740).

[4] As noted earlier, these constructs were also part of the ITC-SOPI instrument and collected along with the engagement scores. The *coefficient alpha reliability estimate* for spatial presence and ecological validity were 0.944 and 0.867, respectfully.

These virtual places are no less real then a physical world classroom space, the geography is no less real, and the experiences are no less real. The results indicate that the more genuine we can make the experience, the more engaged our students are likely to become.

DISCUSSION

The present study is one of the first to empirically examine Second Life™ as a learning platform capable of enabling engaged students. The context for this study provides a convincing example of the power of Second Life™ to create socially relevant, immersive, engaging learning environments. This study examined student engagement at the level of the Second Life™ platform and specifically as students worked with the 3-D interactive accounting equation and t-account. This study has shown that virtual environments can be created that engage students. Our results support the hypothesis that when students are engaged they will perform better. After controlling for age, gender, and ability (via GPA and Internet skills), this study shows a positive relationship between engagement and student learning outcome.

Another unexpected result from our analysis is the negative association between Internet skill and exam score. This seems to indicate that the better a person is with regard to Internet skills the less well they performed on the exam. One plausible explanation for this result is that students adept at using the Internet may be acquiring their skills by spending time on the Internet when that time might be better served getting to know the accounting material.

However, it would be wrong to view these new learning platforms with blinders on or through rose-colored glasses. There can be adverse psychological reactions to these environments, such as dizziness and nausea, and the results of this study show that if students experience these adverse conditions their performance suffers. Fifteen percent of the students completing the survey indicated they experienced one or more of these adverse conditions. As the fidelity of virtual environments increase and new tools are used for movement and navigation (e.g., Mitch Kapor's 3-D web cam), it is possible that we might see a higher percentage of users feeling ill effects. It is thus important to better understand how these effects occur and how they can be mitigated. As we routinely test students for learning styles and direct them toward learning material best suited for their styles, we may need to direct certain students away from 3-D immersive environments if it is determined they are having adverse reactions.

This study has also shown that time-on-task can increase if tools are designed to actively involve the students and allow them to become immersed in the activity. But time-on-task is mediated by adverse affects and gender. This suggests more research is necessary to understand why adverse reactions to the Second Life™ environment would more acutely affect one gender versus the other.

LIMITATIONS

As with any investigation, this study has certain limitations. This study used students from one financial accounting course at a large public university in the southeast Unites States. Thus, the results may not generalize to other student populations.

Another potential limitation to a study of this kind is the ability to have a control group to help determine the extent to which Second Life™'s affordances had in impacting student engagement. It could be those students who did the homework because they were required were already self-motivated to learn or that they were drawn to the visual environment of Second Life™. Additionally, the way in which the survey instrument was constructed it is not possible to ascertain the impact of Second Life itself from the learning objects the students interacted with. Also it is possible that a Hawthorne effect might be driving our results. In other words, since Second Life™ is such a novel tool were students using it just because it was fun. Lastly, since this was an assessment of a course intervention expected to provide benefits to the student, it is not something that can be withheld from one student group. Comparing students in other sections taught by different instructors while controlling for Second Life™ use would introduce other differences that could potentially explain the results obtained. Thus, a limitation of studies such as this will be the ability to control for those who voluntarily do not take part in the treatment.

This study only examined the relationship between student engagement and performance on the first exam as that exam was closest in time to when the students interacted using Second Life™. Thus, we cannot generalize as to the long-term benefits over the course of the semester.

Finally, though our results indicate some students suffered from adverse reactions, we were unable to determine what were the causes of these reactions. It is possible that these reactions can come from either the internal Second Life™ environment (for example when many avatars are together at one time the avatar names that appear above each one undulate which might cause a queasy feeling) or from an external factor (for example, if students were wearing glasses with graduated lenses could also cause feelings of excess motion). Future research might examine these issues in more detail.

CONCLUSION

This research has provided empirical support that student engagement enabled via Second Life™ can lead to improved performance (measured as declarative knowledge), as well as increased time-on-task. Additionally, support has been provided to lay the groundwork for creating necessary conditions for engagement to emerge—a sense of presence within the environment.

Many have begun to explore this new learning platform and we believe many can see how different it is from other technological innovations that have preceded it. But in the end, while learning delivery may change, we as learners have not (at least not at the same rate as the technology used to deliver content). We still require a social environment where we can meet and discuss and learn with others. We still require a level of engagement with the content in order to perform well. It seems that Second Life™ has the capability to deliver these fundamental components to learning.

APPENDIX
SOPI INSTRUMENT

Part A: The first set of questions asked subjects to reflect on their experience after their experience of Second Life™

1. I felt sad that my experience was over.
2. I felt disoriented.
3. I had a sense that I had returned from a journey.
4. I would have liked the experience to continue.
5. I vividly remember some parts of the experience.
6. I'd recommend the experience to my friends.

Part B: The second set of questions asked subjects to reflect on their experience during their experience with Second Life™

1. I felt myself being "drawn in."
2. I felt involved (in Second Life™).
3. I lost track of time.
4. I felt I could interact with the displayed environment.
5. The displayed environment seemed natural.
6. It felt like the content was "live."
7. I felt that the characters and/or objects could almost touch me.

8. I enjoyed myself.
9. I felt I was visiting the places in the displayed environment
10. I felt tired
11. The content seemed believable to me.
12. I felt I wasn't *just* watching something.
13. I had the sensation that I moved in response to parts of the displayed environment.
14. I felt dizzy.
15. I felt that the Second Life™ was part of the real world.
16. My experience was intense.
17. I paid more attention to the Second Life™ than I did to my own thoughts (e.g. personal preoccupations, daydreams).
18. I had a sense of being in the scenes displayed.
19. I felt that I could move objects (in Second Life™).
20. The scenes depicted could really occur in the real world.
21. I felt I had eyestrain.
22. I could almost smell different features of the displayed environment.
23. I had the sensation that the characters were aware of me.
24. I had a strong sense of sounds coming from different directions within the displayed environment.
25. I felt surrounded by the displayed environment.
26. I felt nauseous.
27. I had a strong sense that the characters and objects were solid.
28. I felt I could have reached out and touched things (in Second Life™).
29. I sensed that the temperature changed to match the scenes in Second Life™.
30. I responded emotionally.
31. I felt that *all* my senses were stimulated at the same time.
32. The content appealed to me.
33. I felt able to change the course of events in Second Life™.
34. I felt as though I was in the same space as the characters and/or objects.
35. I had the sensation that parts of Second Life™ (e.g. characters or objects) were responding to me.
36. It felt realistic to move things in the displayed environment.
37. I felt I had a headache.
38. I felt as though I was participating in the Second Life™.

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