Game-Based Experiential Learning in Online Management Information Systems Classes Using Intel's IT Manager 3

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ABSTRACT

For several years, we used Intel's flash-based game "IT Manager 3: Unseen Forces" as an experiential learning tool, where students had to act as a manager making real-time prioritization decisions about repairing computer problems, training and upgrading systems with better technologies as well as managing increasing numbers of technical staff as the game progresses. We found that this experience was useful for students to reflect upon and apply several IT management theories learned in their online Management Information Systems class. Specific reflective questions fostered thinking about the role of the CIO, principles of project management, budgeting IT initiatives, as well as the impact of IT projects on the balanced scorecard. In this paper we first outline experiential learning methods and describe the online course and the module's objectives where we used the game based simulation of the Information Technology manager role. We examine elements of what makes a good game and relate these with key features of the IT Manager 3 Game, and describe how we used them to reinforce theoretical concepts. We then go into detail on what challenges and obstacles were faced when implementing the game in the course and highlight how these were overcome. Finally our paper concludes with a discussion of how online games can be effective in online management information systems courses.

Keywords: Experiential learning & education, Online education, Simulation

1. INTRODUCTION

Experiential learning approaches such as cases (Mauffette-Leenders, Erskine, and Leenders, 1997) or computer simulations and games (Becker and Parker, 2012) can be used to impart greater level of understanding and increased retention of concepts and relationships than more passive educational pedagogy, enabling students to better transfer lessons learned to the business world (Anderson and Lawton, 2009; Shute and Ke, 2012). A simulation can be seen as the recreation of real management situations where participants are allowed to experiment with different decisions, and are permitted to fail and try again while learning to understand the consequences of their actions (Léger et al., 2011) and begin to recognize the complexities of the system dynamics. Functional and factual learning can result from the use of games (Connolly et al., 2012). It is however recommended that pedagogical mechanisms need to be in place in order for deeper recognition and comprehension to develop through the reconciliation of theory and practical experience. We use a strategy of reflection to reinforce students' understanding of the management theories and concepts learned in class which is guided through the use of specific questions. This is consistent with constructionism in game-based education (Ulicsak and Wright, 2010), where learning is reinforced by having to explain it.

The use of digital games as an alternative way to support learning has been examined in various disciplines. The premise is that educational games can increase student engagement and provide an authentic and rich picture of the learner (Shute and Ke, 2012). Games provide context and situations, which are necessary for useable and robust knowledge (Brown, Collins, and Duguid, 1989). Playing games invokes problem solving, creativity, persistence and other valuable skills and competencies required today but not well supported in current educational systems (Shute and Ke, 2012). Research on educational games was virtually nonexistent prior to 2006, and by 2010 made up a small portion (3%) of educational technology articles in the 6 Journals studied by Hsu, Hung and Ching (2013).

Connolly et al. (2012) examined evidence in a meta-study of research articles on games as learning tools. They found that "the most frequently occurring outcomes were knowledge acquisition/content understanding". Dondlinger (2012) describes this learning outcome in other terms as "complex concepts and abstract thinking", in another meta-study on learning outcomes from educational video games. Similarly, Ke's (2009) review of the literature on game based learning also made a similar conclusion, where she

states "An interesting pattern is that games seem to foster higher-order thinking (e.g. planning and reasoning) more than factual or verbal knowledge acquisition." (Ke, 2009, p.22). Simulation games can help students not only develop problem solving skills, but also the skill to anticipate future problems (Lin and Lin, 2014).

We used the IT Manager 3 game in our classes to deepen our students' learning about IT management issues and better internalize the course curriculum by experiencing first-hand how budgets, risks, and employees behave in a dynamic environment.

In the following sections of this paper we discuss prior literature on games in higher education and we summarize characteristics of good games. We then describe how the game we adopted in our online Management Information Systems class contributed to learning. We conclude with a discussion of the outcomes, and recommend how instructors can apply our experience to successfully utilize games such as IT Manager 3 in their courses.

2. THE PEDAGOGICAL VALUE OF GAMES

Games can provide organized and structured play that is voluntary, motivating and requires active physical or cognitive engagement (Shute and Ke, 2012) and which allows for experimentation, identity shaping, freedom of effort and interpretation, failure and recovery (Klopfer, Osterweil, and Salen, 2009; Sutton-Smith and Pellegrini, 1995; Rieber, 1996). A game can be seen as a contest using mental or physical skills to reach goals and objectives, following a specific set of rules and relying on outcomes, feedback, conflict, competition, challenge, interaction, story, or representation, (Hogle, 1996; Prensky, 2003). A succinct definition of playing games is provided by McGonigal (2011) as the voluntary attempt to overcome unnecessary obstacles.

Many researchers have argued that good games, or games that incorporate learning principles (Gee, 2003), are valuable transformative learning tools that support deep and meaningful learning. They can support content-specific learning and the development of complex competencies like problem solving, creativity and organizational skills (Shute and Ke, 2012). Authors such as Rieber (1996) relied on the Piagetian Learning Theory which states that learning can only occur when a person is in a state of disequilibrium (mental structures not in balance) and that new knowledge results from the resolution of the conflict, to argue that games foster, nurture and trigger the necessary equilibrium process for learning. Rieber (1996) also used Flow Theory (Csikszentmihalyi, 1990) to argue that games are engaging and absorbing and can lead to extreme happiness and satisfaction, resulting in psychological growth where an individual becomes more complex or elaborate. Based on Flow Theory, Sweetser and Wyeth (2005) developed and tested GameFlow, a model of player enjoyment in games, which includes a combination of elements (e.g. concentration, challenge, and emersion) that cause deep enjoyment so rewarding that players become absorbed in the experience and are ready to spend a great deal of energy and time playing the game. Good games also put players at the very limit of their ability and skill level, leading them to a state of flow and motivating them to keep playing (McGonigal, 2011). This motivation is the most important factor or the *sine qua none* of successful learning (Gee, 2003; Prensky, 2003). A meta-analysis of literature by Vogel et al. (2006) showed that compared to traditional teaching methods, interactive simulations or games report higher cognitive gains and better attitudes towards learning, supporting the theory that interactive experiential activities increase motivation and learning outcomes.

Klopfer, Osterweil, and Salen (2009) argue that games help students develop necessary skills and habits like collaboration, innovation, problem-solving and communication, and called for the use of games as learning tools applicable to school environments. A study by Guillén-Nieto and Aleson-Carebonell (2012) supports that claim by empirically demonstrating how an intercultural business communication game can increase learning effectiveness.

Wu et al. (2012) conducted a review of learning theories used in game-based learning literature. They identified four types of theories on learning were applied in published studies. Wu et al. categorized several learning principles into the learning theories (Humanism, Constructivism, Cognitivism, and Behaviorism). Of these principles, the authors found the most commonly used were experiential learning theory, situated learning theory, and problem based learning.

Rieber (1996) and Sweetser and Wyeth (2005) identified the characteristics of good games based on the principle of "flow" (Csikszentmihalyi, 1990). Other elements along with examples of the good learning experiences were identified by Gee (2003). Prensky (2003) identified valuable attitudes learners show when playing games. McGonigal (2011) listed four defining traits of games, irrespective of genre and technological complexities. Charsky (2010) defined characteristics as goals, competition, rules, choice, challenges, and fantasy, which can be seen as the motivating force or story that drives immersion. We summarize these characteristics in Table 1 on the following page.

We found that Intel's Flash based game IT Manager 3: Unseen Forces (Intel, 2012) had most of the characteristics of a good game for learning, as highlighted in Table 1. The only lacking characteristic we found is the social one. We adopted this game as it was a good fit with the learning objectives of our course, as the game allows students to explore and appreciate the management of IT position which would normally be inaccessible to them. This opens up new possibilities for learning through harmless simulation (Girard, Ecalle and Magnan 2013).

We developed an assignment around this game for our students to not only experience the challenges of an IT manager, but more importantly to understand and be able to apply some of the IS theories on valuing Information Systems, managing projects and the role of the CIO as discussed in their textbook. The following section will describe the context of the online course in our Bachelor of Commerce program.

3. ONLINE LEARNING CONTEXT

Our undergraduate Business students are required to take a Management Information Systems course in an online format

while they are away from campus completing their work term. The average age of students taking the class is 20.5 years old. The student population in our program is 59% male and 12% of our cohort originated from outside Canada with the largest groups from China, Bahamas and Bermuda. Students graduating from our programs major in Accounting (26%), Marketing (19%), Finance (20%), Commerce (19%), with the rest (16%) in the smaller majors; Marketing Logistics, International Business, Managing People and Entrepreneurship. We do not have an MIS major, and this class is the second required course in IS. The first course focused on personal productivity software in student's first year of the program. This MIS course is aimed towards the management issues of IS instead.

Characteristics	Rieber (1996)	Sweetser and Wyeth (2005)	Gee (2003)	Prensky (2003)	McGonigal (2011)	Charsky (2010)
Flow, Challenge and Immersion	Optimized challenge Absorbed attention Disappearance of self-consciousness Transformation of time	Concentration Challenge – match player's skill level Immersion – deep but effortless involvement	Increasing complexity – initial levels hidden tutorials and purpose	Interesting		Challenges Fantasy
Control	Complete control of activity	Control over actions	Outer edge of competence (challenging but doable)		Voluntary participation	Choice (expressive, tactical or strategic)
Goals	Clear goals	Clear goals	Motivating (customized to ability and style of learning) Motivating (drives learning)	Active seeking information and solutions Results-oriented	Rules (push players creativity and strategic thinking) Goal (sense of purpose)	Goals Rules
Feedback	Clear and consistent feedback	Feedback – appropriate and timely	On-demand, just in time info within context		Feedback system (motivates players)	
Social		Social interaction	Collaboration and sharing knowledge, skills and values	Competitive Cooperative		Competition
Learning		Player skills' development and mastery	Production - not just consumption of knowledge Repeated cycles of new problems (development of new skills)			

Table 1. Characteristics of Good Games

The format of the course was set up so that every two weeks several topics are discussed and integrated using an activity and assignment that integrates theories presented in the text with practical applications. This bi-weekly module format works quite well for students working full time, as it allows some flexibility when they can invest the time to complete the readings and assignments. It also enables for the asynchronous class discussions to be long enough for several iterations of responses, points and counterpoints.

In the Management Information Systems class, the 4th two-week long module covers three topics based on the MIS textbook Pearlson and Saunders (2010) which are: Governance of the IT Organization, Funding IT, and Project Management. These three chapters were combined because they examine different aspects of decision making and implementing IT initiatives. The learning objectives for this module are for students to understand the role of the CIO in the organization, to be able to apply valuation of IT and balanced scorecard approaches to justifying IT investments and to understand the elements of project management including how projects change when unexpected events occur.

To accomplish these learning objectives through an integrative exercise, we could have chosen a traditional IS

case; however we decided that playing a game was more immersive and interactive than a text based case on IT Management.

4. THE IT MANAGER 3 GAME

Prior to the assignment where students play the game and complete the reflective questions, we assigned readings and quiz covering the Governance of IS, Funding IT and Project Management based on the theories presented in chapters 8, 10, and 11 of the textbook, "Managing and Using Information Systems", Pearlson and Saunders (2010). Following this, students were introduced to the simulation game and instructed that when they play it they should pay attention to how their role evolves during play, take note about how the game is different than real life, and think about why Intel created this game and how it can be justified from an IT funding and balanced scorecard perspectives.

Students create a username, and read through the short player guide on Intel's website, which has explanations of the functions in the game as well as what IT Chi is. The goal of the game is to effectively run the IT staff of a growing company by maintaining and updating IT assets with limited budgets while keeping users happy and productive. IT Chi is a concept used in the game which is the achievement of balance between existing skills and the need to introduce new technology.

Players of the IT Manager 3 game have several activities to perform under the pressure of the ever advancing time. The first is to maintain current systems in the company. There is a server room with racks of servers that need to be taken care of (Figure 1). There are also several floors of offices, including those for executives, sales people, and production staff that all have different job requirements and thus varying IT needs (Figure 2).

Figure 1: a server room in IT Manager 3

As problems arise, players can fix these using hardware, software or rebooting (Figure 3). Employees have different levels of "bozons" (a measure of technical savvy), where the employees with low "bozons" are more prone to encounter problems with their systems. In addition to fixing IT, the player can train in new technologies and then selectively deploy upgrades, which all happen to be Intel based products. These can improve heat efficiency, storage capacity, processing speed, security or mobility, for example. Each computer or server upgraded costs money from the budget, so prioritization decisions need to be made in terms of what technologies to adopt and on whose computers to deploy them on. This has to be done while being constantly interrupted by employees whose computers are perpetually malfunctioning, often from user error or the player's lack of keeping pace with upgrades.

Figure 2: An office in IT Manager 3

After achieving a certain score, the player's avatar gets promoted to a new city where there are more floors of offices as well as some subordinate staff, who can also be trained to install new technologies and deployed to fix problems. Subsequent promotions increase the number of staff and floors, servers, and employee computers. This progression keeps the game challenging and involving, as well as quite stressful at times when trying to keep up with all the service requests.

Figure 3: Employees needing assistance

5. REFLECTIVE QUESTIONS

Students were instructed to play the game until progressing to the third city, which can take an hour or longer and then they are to reflect on the linkages between theory and the

game using a set of questions asking them to consider their actions and decision making behaviors.

The first set of questions asks them to consider the main responsibilities of the CIO and explain the actions they took in the game and how they could be related to some of these responsibilities. Students were also asked how their role evolved over time and how they would automate their subordinates to take on more decision making responsibility.

The second set of questions examines what project management elements outlined in their lessons are applicable to the game and how the game is a controllable predictable environment whereas real IT projects are not. Students also reflect on what shortcuts they took when managing their IT projects, many of which were because they did not watch their budgets or they fell behind because of problems constantly popping up.

The third set of questions had students reverse engineering the decision making process at Intel when the IT Manager 3 game was approved for funding. With a few assumptions around the costs, students are asked to justify this game from a financial perspective as well as from a balanced scorecard perspective.

Finally, we asked students to describe what they learned about Managing IT and IT budgets by playing this simulation of an IT manager's world. The assignment and grading rubric can be found in Appendices A and B.

6. LEARNING OUTCOMES

Students reported that they learned that managing technology and information systems is chaotic, disorderly, stressful, frustrating, dynamic, intense, hard, unpredictable, challenging, overwhelming, and difficult, but in general it is interesting. Among the valuable lessons learned by students are that the IT manager has multiple roles and requires many skills. Besides the technical skills, the IT manager requires communication and people skills; should be able to build a solid support team, provide them with adequate and timely training, and be able to keep them motivated. IT managers should be able to keep all employees satisfied and productive as the organization's performance, and hence their evaluation, depends largely on the employees' performance.

In terms of IT budgeting, students reportedly learned from the simulation that prioritization is the key to success and that unexpected events, mainly in the form of technical problems, should be accounted for by keeping emergency funds in the budget. They also learned that IT budgeting is very complex, that it is directly related to productivity and that in many cases managers end up taking shortcuts. A major problem they faced was that they needed to show an increase in productivity as a justification for getting additional funds, but that they sometimes need additional funds to increase productivity, which put them in a vicious circle.

Table 2 depicts the distribution of the students' learning reflections on what is important about when managing IT budgets. We felt that these student comments were useful insights for the class about the challenges of managing IT.

What did you learn about Managing IT Budgets while playing the game?	Percent	Frequency
Expense planning and prioritization of projects are important to increase productivity and avoid running into a debt situation	54%	27
Upgrades are important to keep investing in regularly to raise productivity	26%	13
Company success and increased budgets comes from employees productivity, which is tightly linked to happiness	26%	13
Cash flow becomes a problem whenever there is a crisis such as a server crash, thus it is important to have a reserve.	22%	11
Productivity increases once IT problems are resolved for employees, only then is the budget big enough for investments in new technology	20%	10
It is difficult to budget for unexpected repairs	16%	8
Decisions need to be made at a fast pace	14%	7
Investing in Employee training increases productivity and budgets	12%	6
Look at IT spending as investment	12%	6
Over spending on new technology takes away necessary funds from maintaining employees' systems, leading to reduced productivity	10%	5
The most expensive option is seldom the best one, targeting investment gives better return on investment	10%	5
IT should meet business user needs	10%	5
It is important to understand the potential technologies you can invest in	6%	3
Antivirus is worthwhile investment.	4%	2

Table 2: Learning Reflections on IT Budgets

The value of gaming elements can be observed in the students' comments about their ability to make many mistakes and fail multiple times until they got things right. Students explicitly stated that they experienced things they did not anticipate and that they eventually ended-up with a better understanding of and a higher appreciation for the job of the IT manager. When asked about what they learned from the game, students used terms such as; a better picture, eye opener, real-life, better perspective, wake-up call, many scenarios, realization, experiential, accurate example, better and new understanding, perception change, and surprise. These adjectives clearly highlight the simulation's value as a teaching tool complementing the course's formal material.

The general level of contribution in this exercise was good as many students completed the exercise achieving results above 4 out of 5 marks. Students were allocated grades using the rubric attached in Appendix B. The class grade distribution for the assignment is shown in Table 3 below.

Grade	0	2 to 3	3 to 4	4 to 5	5
Count	4	1	5	32	12

Table 3: Assignment Grade Breakdown

7. ROADBLOCKS

Despite the clear pedagogical value of the game, students experienced some obstacles and hurdles while playing IT Manager 3. The major issue was the malfunction of the game the day the assignment was due where a black screen with blue lines appeared instead of the game's interface. We are still unclear what caused that the problem, as we had no way of contacting the proper people at Intel to report this, so the deadline for the assignment submission was extended and the game was functioning normally a day later.

A second problem faced by some students was their inability to move forward to the next level in the game as was required in the assignment. These students could not figure out their mistakes and the way to correct them and the system did not provide sufficient feedback or a backdoor to move forward. These students were frustrated as they found the game to be hard to play and a couple unfortunately ended-up copying the assignment from their colleagues.

The course had an online discussion forum setup with more than fifty topics created by students each semester, but none were related to the simulation and its issues. This may be related to students' image (did not want to confess their inability to play the game), or to the fear of being accused of collaboration on an individual assignment.

8. RECOMMENDATIONS

Online games, such as IT Manager 3, are a particularly useful experiential tool in online classes where students are completing class asynchronously on their own schedule. One benefit of using these sorts of games is that nobody needs to administer user IDs and software installation, which can be a difficult thing to manage in online courses where everyone has a different computing platform. Another benefit is that the experience can be highly engaging for the student, which is something that most online classes struggle with if conducted asynchronously.

Since using Intel's IT Manager 3, we are confident of the use of online games as learning tools, particularly when used as part of a graded assignment. Instructors planning to use it or a similar simulation are recommended to anticipate scalability or other technical problems and have contingency plans such as having contact information to report urgent problems or extend the assignment deadline.

To enable students who are struggling to progress in the game, we recommend setting a time limit of 3 hours, making it clear that it is alright to fail at the game as long as you can explain what happened and how it relates to the learning materials. This works as there is no grade assigned to the in-game score, instead marks are assigned to the students' demonstration of learning. For this it is beneficial to develop a rubric that reflects students' effort and learning irrespective of how much progress they achieved particularly because not all students have the same ability and interest in playing games.

Finally, we recommend that instructors setup an anonymous online forum where students can discuss the game mechanics and functions as well as their experiences and ask for help with confidence. This should be done while making it clear to students that discussing gameplay tips and helping classmates proceed through the game is permitted and encouraged, so long as the answers to assignment questions are not discussed as it is an individual assignment after all. This approach can bring in the social characteristic (as in Table 1) of good learning games, which we were previously lacking.

9. CONCLUSIONS

Game based simulations can be powerful teaching tools in online information systems classes, when used to apply and internalize management concepts. Simulation games such as the IT Manager 3 game used here can be an effective method of conveying the complexity of managing projects, having conflicting funding priorities in IT, and managing risk.

We recognize that we cannot generalize from this experience alone about the value of games, and recommend that future studies endeavor to contrast the impact of a traditional case, or multimedia presentation versus a simulation game on students' learning outcomes. This would allow a quantifiable effect size to be determined, which could be used to justify the investment in future learning based simulation games.

The main contribution of this study was that we demonstrated how one can adapt an existing simulation game, freely available on the Internet, in such a way to create a meaningful learning experience for students. This is especially valuable for students in online management information systems courses, where a lack of common locality can be overcome through a shared experience.

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Appendix A: Assignment Questions

Students were asked to submit their responses to the following questions for 3 perspectives:

1) Perspective 1: Your role in the game.
a) What is your role in the first city, and how does it evolve in the second?
b) How did you decide what order to upgrade computers in? (i.e. which ones did you upgrade, with what first, and why?)
c) Explain which of the 12 main responsibilities of a CIO (on Page 220 of the text) fall under your domain?
d) Assume that you can change the game, and can give your staff the ability to go do things on their own instead of having to click them all the time. What would you program your staff to do autonomously? Are there certain actions you would *not* want your staff to do on their own? Justify.

2) Perspective 2: Project Management Perspective
a) Use your IT Manager 3 experience to explain why sometimes shortcuts are taken when managing IT projects in the real world. (As opposed to using the methods in the text).
b) In IT Manager 3, projects always go without any hiccups, e.g. server upgrades are always problem free because you use Intel products and Intel designed the game. Explain what project management elements in figure 11.6 (p. 320) are applicable to the game?
c) Explain what a controllable, predictable environment is. Is the IT Manager 3 game a representation of this? How / how not?

3) Perspective 3: Intel's Perspective on the Business Case for IT Manager 3
a) Assume you are the Intel manager responsible for the $1,000,000 development cost, $20,000/month hosting cost attributable to the IT Manager 3 Game. The time is one year before the game is launched. How can you make a business case for this investment in one or two paragraphs thinking about costs, risks, and benefits? Make any assumptions that you think are appropriate or look them up online. (For example FACT: Intel's Revenue in 2010 was $43.6 Billion; ASSUMPTION: roughly 0.02% of the university educated population understands how Intel's products work, even though 80% own them.)
b) Again, assume you are working for Intel. What is the impact of IT Manager 3 on the 4 Dimensions of a Balanced Scorecard? In other words, how does the game influence the questions in Figure 10.11 (p. 298) for Intel?

4) What did you learn about Managing IT Budgets while playing the game?

5) What was your UserID and Company Name?

Appendix B: Grading Rubric

Out of 5	**Unsatisfactory/ Missing (0)**	**Marginal (0.8)**	**Satisfactory (1.2)**	**Excellent (1.5)**
Perspective 1: Your Role	Missing or missed the point	Answers were overtly simple, lacking evidence of understanding of the chapter	One or two of the questions missed minor details which could have been included	Answered all 4 questions clearly while making use of the experience and the information in the relevant sections of the textbook.
Perspective 2: Project Management	Missing or missed the point	Answers were overtly simple, lacking evidence of understanding of the chapter	One or two of the questions missed minor details which could have been included	Answered all 3 questions clearly while making use of the experience and the information in the relevant sections of the textbook.
Perspective 3: Intel Business Case for Funding ITM3	Missing or missed the point	Answers were overtly simple, lacking evidence of understanding of the chapter	One or two of the questions missed minor details which could have been included	Answered both questions clearly while making use of the experience and the information in the relevant sections of the textbook.
Learning IT Management	Missing or missed the point	Only provided an answer for either question 4 or question 5	Provided Username and Company Name, and answered question 4 with some basic effort	Demonstrated a reasonable set of insights from the experience and included UserID/ Company Name

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