Lessons Learned from using Gamification for Teaching Business Informatics to First Year Undergraduate Students

Completed Research

Amir Talaei-Khoei
University of Nevada Reno, USA
University of Technology Sydney, Australia
atalaeikhoei@unr.edu

Donald Kerr
University of the Sunshine Coast
Australia
dkerr@usc.edu.au

Luvai F. Motiwalla
University of Massachusetts Lowell, USA
Luvai_Motiwalla@uml.edu

Abstract

The paper aims at utilizing the learner-centered framework in game-based learning. While there has been a body of research on the application of games in teaching, the question, "how can games be integrated into learning theories to improve students' experience?" has largely been ignored. Therefore, there exist conflicting findings on the effectiveness of games for students' learning in the literature. The present article has reported the use of the Beer Game to teach basic concepts of business informatics to undergraduate students and provide insights on lessons learned for the successful deployment of game-based learning in classrooms. The paper describes an experiment from four perspectives of the learner-centered framework; namely cognition, motivation, social skills and assessment. The study found that although game-based learning is relatively motivational, to provide a sufficient level of cognition to learning outcomes, there should be a direct and descriptive link between the theoretical perspectives and the application of the game. This can be achieved by involving games in the assessment tasks. In addition, games that can be played in collaborative and/or competitive environments can also enhance student understanding of the learning objectives of the assignment.

Keywords
Gamification, learner-centered teaching.

Introduction

A key challenge in teaching an introductory business informatics subject to first year undergraduate students is keeping the students engaged and motivated in the course materials. The traditional model of a lecture-based approach discusses information systems concepts with technical component examples and use examples. Unfortunately, students are not motivated despite having lived in the midst of technology all their lives. Due to this, learning situations and methods that engage learners must be created (Killi, 2005).

Traditional learning is regarded by many as inefficient when applied to the development of problem solving skills and critical thinking skills because it allows students to be passive recipients of "predigested" information from the professor (Hansen & Stephens, 2000, p. 42). Thus, students become dependent on the professor to tell them what they need to know and can avoid taking responsibility for their own learning (Machemer & Crawford, 2007). Furthermore, students accustomed to being passive have a "low tolerance for challenge" (Hansen & Stephens, 2000, p. 46). Finally, according to experiential learning proponents, learning as a result of lectures is relatively superficial and transient (Moust, Van Berkel, & Schmidt, 2005). Today, business informatics professors are chastised for continuing to use traditional lecture approaches and are encouraged to adopt approaches wherein the students are responsible for their own learning through problem solving and discovery.

Business informatics (BI) is not only about providing information skills but also about facilitating student experiences on the application of IS to business problem solving. To improve a student's understanding of the BI concepts, we have adopted a supply chain game, called the *Beer Game*, to facilitate student learning through gamification. The main objective of the game is to ensure that students learn how to apply informatics tools in business decision making. Our findings indicate that, although students had an entertaining experience in relation to the subject, the effectiveness of the *Beer Game* (Chalam 2011) on student learning was not sufficient. This observation is supported by the conflicting results reported in related literature. Potential reasons for this insufficiency could be due to teaching method. The lecture method is effective for teachers who lecture well, and experiential methods are effective for teachers who are adept at developing meaningful in-class activities. For example, some researchers caution that for experiential approaches to be effective, teachers must provide significant guidance and structure: students left to their own explorations of solutions to the problem may not learn without adequate mentoring and support from their professors (Covill, 2011).

Therefore, the effectiveness of game-based learning is related to not only the nature of the approach, but also on the context and deployment of the game(s) (Hainey et al. 2016; Soflano et al. 2015). There are two streams of research aligned with this topic 1) experimental learning and 2) experimental learning using gamification. The experimental learning has shown effective results in literature (Fominykh et al. 2017; Jose et al. 2017; Saraswat et al. 2017). In terms of using games for experimental learning, while some educators see games as a useful and perhaps even necessary learning environment (Hainey et al. 2016), related literature has highlighted obstacles for the effective deployment of game-based learning (Jan et al. 2015). There is a body of research on the use of games for education purposes; however, a common understanding has not been reached regarding how this approach can be effective (All et al. 2015; Qian and Clark 2016). First Section presents a summary of articles that have reviewed the literature in game-based learning, our findings showed that literature since 1992 has been reporting conflicting results on the positive influence of game-based teaching on students' learning experience. It is commonly believed that the context of teaching through the deployment of gamification in the learning environment significantly impacts the effectiveness of student learning. (Hainey et al. 2016; Soflano et al. 2015).

The main objective of this research is to assess the professor and student experience on the use of games in the introductory business informatics course with freshman students, and discuss the lessons learned from this experience. In order achieve this, we have applied a learner-centered approach (Webber 2012).

This paper is organized in as follows: Section 1 presents learner-centered approach and research context, Section 2 presents the theoretical framework used in this study, Section 3 presents the methods used for data collection and analysis, Section 4 presents the findings of this study, and Section 5 discusses the results and concludes the paper.

Learner-Centered Approach

McCombs (1997) explained that the locus in a learner-centered approach is on the individual learner's heredity, experiences, perspectives, backgrounds, talents, interests, capacities, and needs. From a research-based perspective, she defines "learner-centered" as a foundation for clarifying what is needed in order to create positive learning contexts that increases the likelihood that more students will experience success. Barr and Tagg (1995) proposed a paradigm shift in teaching from the instructor perspective to the learner wherein the learning experience is evaluated from a learner's perspective. The learner-centered approach (Webber 2012) focuses on learning processes and outcomes of individual learners. It introduces fourteen principles in four categories: Cognition, Motivation, Social Skills and Assessment. The 14 specific principles within these categories are based on research and define much of what is known about learning and learners.

There is a body of literature adopting the learner-centered approach and improving the effectiveness of learning. Eguchi (2017) uses learner-centered approach to teach principles of robotics. Malu and McNeal (2017) adopted a game wherein students create cartoons to learn English literature. Motschnig et al. (2016) combined the team-based approach and learner-centered principles in order to create a large class of human-computer interactions .

Figure 1 Learner-Centered Approach (Webber 2012)

Research Context

In response to Higher Education Provision of Australian Qualifications Framework for business degrees (AQF, 2013), the school of business at the subject university offers an introductory subject for business informatics to all first year undergraduate business and accounting students. The course offers a general coverage of informatics topics. The goal of the course is to equip business students with a fundamental knowledge of informatics.

Issue: Why learn informatics?

The informatics subject has been available since 2009, at which time there was a general understanding among the teaching team that the course could not motivate students and attract their interest. As such, in 2011, a report was produced by analyzing student comments regarding informatics since 2009. The study was conducted by one member of the teaching team. The study process included reviewing the detailed comments from the students and summarizing them into three main concerns that will be explained below. The report indicated that students were experiencing the largest difficulties in (1) understanding the informatics concepts. This issue has been also widely reported by literature (Beauchamp 2017; Van Leeuwen and Tanca 2007). Consequently, the students failed to (2) realize the significant role of informatics principles in their future jobs and (3) see the relevance of informatics skills to their university studies. This problem is aligned with what has been learned by (Frauenheim 2004). As a result, the course was perceived to be boring by students and the participation rate in activities was low. Seethamraju et al. (2006) has described a similar situation in which a business informatics course was considered boring for students, that study also reported a low participation rate.

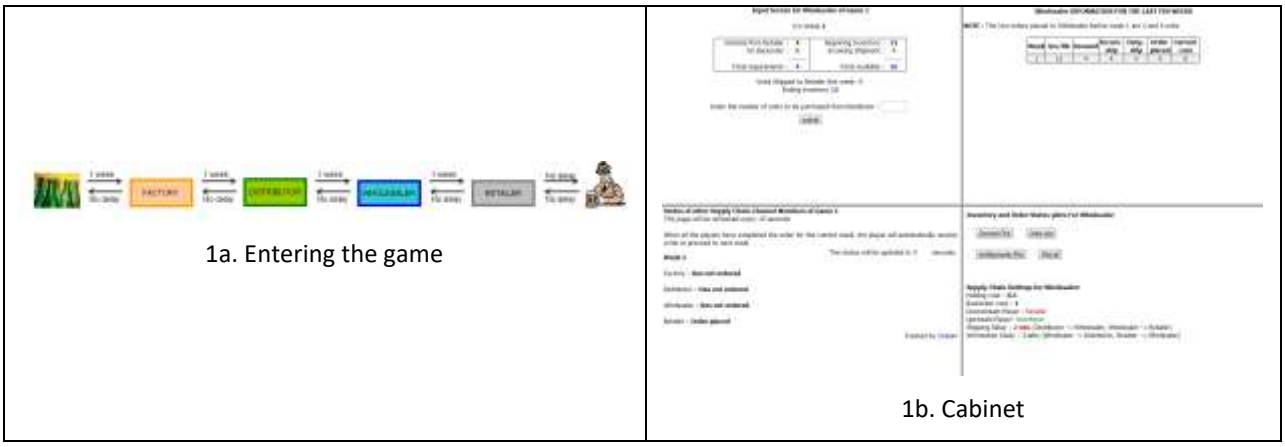
Given the three concerns raised by the report and the advice learned from the literature, it was determined that the students lack of interest in the course could be addressed by a solution that should (1) be experiential, (2) should demonstrate real world scenarios and (3) should be entertaining; see Table 1. These solutions were considered in the recent delivery of the course when the online *Beer Game* (Chalam 2011) was deployed.

Issue	Characteristic of intervention	Supporting literature
Students do not understand informatics concepts	The intervention needs to take an *experiential* approach.	(Beauchamp 2017; Van Leeuwen and Tanca 2007)
Students do not see the relevance of informatics skills	The intervention needs to deploy *real life applications* of informatics skills.	(Frauenheim 2004)
The course was perceived as dull.	The intervention should be *entertaining* and fun for students.	(Seethamraju et al. 2006)

Table 1 Characteristics of the intervention that could improve the course

An experimental role-playing approach using the Beer Game

The *Beer Game*, initially developed by Sterman at MIT (1984), is widely used by business schools to demonstrate the lack of information and communication in the supply chain process from factory to the retailer. Players take one of four roles in the supply chain: Factory, Distributor, Wholesaler and Retailer. The online version of the beer game (Chalam 2011) was deployed in the course outlined in this paper. Details about the game have been left out due to space limitations.



1a. Entering the game

1b. Cabinet

Figure 2 Online Beer Game Course Deployment

Students in each section were separated into four groups: *Factory, Distributor, Wholesaler* and *Retailer*. Each week, the groups would play two rounds of the game and in each round, they were required to place an order indicating the number of beer cases that they would need to be delivered in the following week. Students played the game for 10 weeks or 20 rounds and were motivated to play the game through the incentive of extra marks that would be awarded to the winning group. In addition to the *Beer Game*, the students were learning skills associated with Excel. As a practical assessment task in week 11, students were asked to use the data generated from the *Beer Game* and analyze the trends using an Excel spreadsheet in order to hypothetical determine the optimum order to place in week 41. Note that week 41 was chosen intentionally in order to prevent students from predicting the optimum order by reviewing the last few weeks manually. Students were required to use Excel in order to analyze the existing patterns in the *Beer Game* beginning at round 1 and continuing until round 20.

Methods

In order to evaluate the properties of learners in a learner-centered framework, a grounded research theory (Baskerville and Pries-Heje 1999) was selected in order to extract lessons that can be learned from the intervention. Grounded Theory is a research tool which enables researchers to seek out and conceptualize the latent patterns and structures through the process of constant comparison between the theory and the experiment (Glaser and Strauss 2009). The purpose of grounded theory is to learn through data collected from practical settings, leading to the creation of new knowledge that can be applied in similar settings (Corbin and Strauss 1990). In the following sections, we explain the steps taken in this study and the outcomes, see Figure .

Figure 3 Research process

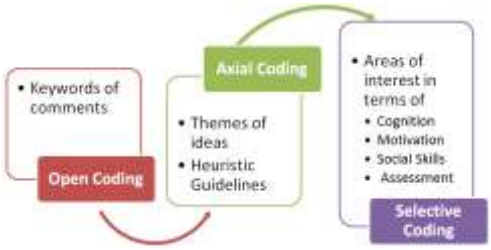


Figure 4 Data analysis

As such, this paper analyses the course coordinators' observation and students' comments in order to provide lessons that have been learned from deploying the *Beer Game* for first year introductory informatics courses. In order to do so, a coding of students' comments and of the course coordinators' note of his observations was conducted against a learner-centered framework (Webber 2012). The observations were also evaluated by students.

Data was collected from three sources:

1. Students' feedback comments. The data was extracted from course evaluations conducted at the semester end. The evaluation consisted of qualitative, open-ended questions that ask for positive

and negative points for the course. The data was collected from seventy-seven relevant responses out of two separate sections of the same course in the same semester. The relevance was determined by comments regarding the deployment of the *Beer Game*. The 77 responses equated to 22.64% of the total number of students. The average age of students was about 22.4 years.

2. Observation during the course delivery. The data was collected from direct observations of the course coordinator in the tutorial session, as well as weekly discussions with other members of the teaching team.

The analysis of the transcripts and notes for each of the data collected was conducted in three steps; see Figure . An extensive open coding was run to identify the keywords. The axial coding put the keywords together and formed the themes where, in the selective coding, these themes were compared against the learner-centered principles, resulting in the extraction of evaluation statements. This provided a complete assessment based on the framework.

Results: Findings from Students and Teachers

Learner's Cognition

Although students believed that the game was a good approach towards understanding informatics concepts, they recognized a disconnect between the explanation of the concepts taught in the lectures and their use of the game. Given the fact that the game was relatively complex, the lack of descriptive instruction could impact on achieving the objective. Students were also asked to demonstrate their Excel skills while facing a practical problem. Overall conclusion illustrates that the *Beer Game* has the potential to provide cogitative improvement in relation to the practical use of informatics concepts, however for this to occur, the points shown in Table 3 need to be considered when deploying the game.

Principle	Evaluation
Nature of the learning process: The learning of a complex subject matter is most effective when it is an intentional process of constructing meaning from information and experience.	Students' comments: E1.1 The Beer Game simulation was beneficial and helped me understand the applications of informatics. Observation: E1.2 The Beer Game could have been more successful if students were informed of the theoretical concepts used in the game.
Goals of the learning process: The successful learner, over time and with support and instructional guidance, can create meaningful, coherent representations of knowledge.	Students' comments: E2.1 The game can attain its objectives, if instruction on how to play were descriptive enough. Observation: E2.2 Students were facing difficulties in playing the game, because they were not given a step-by-step playing guide.
Construction of knowledge: The successful learner can link new information with existing knowledge in meaningful ways.	Students' comments: N.A. Observation: E3.1 There was no connection between the lectures and the beer game.
Strategic Thinking: The successful learner can create and use a repertoire of thinking and reasoning strategies to achieve complex learning goals.	Students' comments: N.A. Observation: E4.1. The Beer Game helped students practice their reasoning skills. For example, using the data from the previous rounds to decide what the optimum beer order to place was. E4.2 The beer game introduced the application of Excel as an analysis tool
Thinking about thinking: Higher order strategies for selecting and monitoring	Students' comments: N.A. Observation:

mental operations facilitate creative and critical thinking	E5.1 The general problem solving skills in the context of informatics i.e. analysis-Design-implementation-test could have provided a helpful framework for students to improve their Excel skills.
Context of learning: Learning is influenced by environmental factors, including culture, technology, and instructional practices.	Students' comments: E.6.1 the open source online platform was buggy and technically difficult to navigate for some students Observation: E.6.2 Although the concept of beer game is independent of beer, choosing beer as a subject fitted well with Australian culture.

Table 2: Cognition Evaluation

Learner's Motivation

At the end of the game, the members of the group whose costs were less than the other groups were awarded extra marks. It was mentioned by students that the competitive context in the game increased their interest in tutorial sessions, and it was observed that students' participation and contribution was high. However, students did not have enough time to accurately consider their decisions. Therefore, it could, to some extent, reduce students' motivation. Overall, using the *Beer Game* to teach informatics concepts could increase the student motivation.

Principle	Evaluation of using Beer Game
Motivational and emotional influences on learning: What and how much is learned is influenced by the learner's motivation. Motivation to learn, in turn, is influenced by the individual's emotional states, beliefs, interests and goals, and habits of thinking.	Students' comments: E.7.1 Playing the game was entertaining. E7.2 The competitive context in tutorial sessions was motivational. Observation: E.7.3 Students' were strongly motivated to practice Excel exercises to optimize their order and win the game. E.7.4 Students' participation in tutorial classes was surprisingly high.
Intrinsic motivation to learn: The learner's creativity, higher order thinking, and natural curiosity all contribute to motivation to learn. Intrinsic motivation is stimulated by tasks of optimal novelty and difficulty, relevant to personal interests, and providing for personal choice and control.	Students' comments: N.A. Observation: E.8.1 The game required students to think creatively when placing an order based on their understanding of the supply chain from previous rounds. E.8.2 Students were following up their orders and were curious to know how many beer cases they needed to order for the next round. This increased their motivation and accordingly their participation.
Effects of motivation on effort: Acquisition of complex knowledge and skills requires extended learner effort and guided practice. Without learners' motivation to learn, the willingness to exert this effort is unlikely without coercion.	Students' comments: N/A Observation: E.9.2 Students did not have enough time to think through their decisions on the order they had placed.

Table 3 Motivation - Evaluation

Learner's Social Skills

The social context was deployed through (1) having students in a group collaborate while playing the supply chain role and (2) providing a competitive environment amongst the roles. As the task was a group task, all the members of the group worked together as team to analyze the data through Excel. It was also discovered that students were sharing their Excel skills with other members of their group; see Table 4.

Principle	Evaluation of using Beer Game
Developmental influence on learning: As individuals develop, they encounter different opportunities and experience different constraints for learning. Learning is most effective when differential development within and across physical, intellectual, emotional, and social domains is taken into account.	Students' comments: N.A. Observation: E.10.1The interactive and competitive nature of the game encouraged students to discuss strategies for better order placement.
Social influences on learning: Learning is influenced by social interactions, interpersonal relations, and communication with others.	Students' comments: N.A. Observation: E.11.1 Students were discussing how to use Excel to place a better order. E.11.2 In order to get better results, students had to consider the choices other groups made i.e. their competitors. This resulted in them being more attentive to the value of information.

Table 4 Social skills: Evaluation

Learner's Assessment

The reason behind using the *Beer Game* as an assessment tool was based on asking students to predict the optimum order to place in week 41. The round-based nature of the game and the feedback that students could receive through detailed information provided in the game.

Principle	Evaluation of using Beer Game
Individual differences in learning: Learners have different strategies, approaches, and capabilities for learning that are a function of prior experience and heredity.	Students' comments: E.12.1 Students with no experience in using Excel were disadvantaged compared to those that had experience. Observation: E12.2 Students' prior skills in using Microsoft office package could significantly impact their performance in the assessment and accordingly influence the fairness of assessment for each group.
Learning and diversity: Learning is most effective when differences in learners' linguistic, cultural, and social backgrounds are taken into account.	Students' comments: N.A. Observation: E.13.1 Making decisions on their own generated data and using their own prediction model for the optimum order to place was an advantage in that it provided some room for students to personalize the assessment to suit their own diverse needs.
Standards and assessment: Setting appropriately high and challenging standards, and assessing the learner and learning progress including diagnostic, process, and outcome assessment, are integral parts of the learning process.	Students' comments: N.A. Observation: E.14.1 Students' decisions were constantly examined during each round of the game and compared to results. This gave them the opportunity to improve their strategy for the final results. E14.2 The patterns of demands was given by the course coordinator and this allowed the teaching staff to leverage the difficulty of the game and step-by-step make it challenging.

Table 5 Assessment – Evaluation

Discussion and Outlook: Lessons Learned[1]

Table 7 presents the lessons learned from our deployments of the *Beer Game*. In order to develop the guidelines presented in this section, we have used the student comments and the observations of the teaching team; however, we have only considered those observation results that have been acknowledged by students. The feedback for the task performed on the game have significant effect on student learning. We found that it is most useful for the tutor to provide a detailed explanation at the beginning of the course of the game, rules, and strategies to win. In addition, there is a significant contribution in learning outcomes if the lecture provides weekly discussion on the application of the topic relevant to the week in the game.

Principle	Lessons Learned
Nature of the learning process	L1.1 In order for games to be an effective instrument in learning complex concepts, they need to provide experience in a real-life context rather than imaginary scenarios.
Goals of the learning process	L2.1 A detailed manual explaining how to play the game should be provided to learners prior to deploying the game.
Construction of knowledge	L3.1 Games simulating experimental contexts will improve learning, if the link between theory and the experiment is provided to the learner.
Strategic Thinking	L4.1 Games based learning allows teaching staff to introduce tools to assist in the process of reasoning. This provides a context for tool use by the learner.
Thinking about thinking	This research cannot provide valid conclusion on this theoretical construct.
Context of learning	L6.1 The context of the game, narratives, and scenarios should be chosen carefully with respect to the individuals' age-characteristics and cultures.

Table 7 Cognition - Lessons learned

Table 8 presents the lessons learned on motivating students by deploying an experimental game when teaching business informatics courses. Overall, this approach is relatively motivational. However, we found that defining take home assignments.

Principle	Lessons Learned
Motivational and emotional influences on learning	L7.1 Game-based learning can be more effective while students play in groups.
Intrinsic motivation to learn	L8.1 game-based learning is most motivating, if it can be customized based on the learners' preferences.
Effects of motivation on effort	L9.1 The effort required for playing the game should fit with the time given to students for this activity.

Table 8 Motivation – Lessons learned

Table 9 presents the lessons learned on improving the students' social skills through role playing experiential games. While students were working together in groups as a team, the groups were competing to win the reward of extra marks. This study found that role playing approaches providing either a collaborative or competitive environment can improve the social skills of students. It is recommended that students also play these games in groups as it encourages teamwork.

Principle	Lessons learned
Developmental influence on learning	L10.1 Playing games in interactive and competitive contexts can improve learning outcomes.
Social influences on learning	L11.1 Cooperative context in games can be deployed by asking learners to work in groups and this improves learning outcomes.

Table 9 Social skills – Lessons learned

[1] Lx.y presents the lesson learned from data Ex.y1, Lx.y.2, …

Table 2 presents the lessons learned on assessing students based on games. The assessment was designed to use Excel skills in order to analyze the data generated during the game, which made it possible for students to be assessed by utilizing the application of their knowledge and not the knowledge itself.

Principle	Lessons Learned
Individual differences in learning	L12.1 Assessments based on the quality of the game results should consider the prior knowledge of learners with respect to skills that might influence the results.
Learning and diversity	This research cannot provide valid conclusion on theory.
Standards and assessment	L14.1 When choosing the game, the ability to leverage the difficulty of the game in a step-wise manner should be considered.

Table 2 Assessment – Lessons learned

Overall, we found that the *Beer Game* provided students with a useful tool to improve teamwork and social skills; however, we are not confident in recommending the game to improve basic understanding of relevant informatics concepts. This is because the learner-centered approach, such as the game, must be endorsed by the faculty who make decisions regarding what is appropriate for their learners, and then select beneficial strategies. Instructors should be provided with training on linking the game to the concepts in order to have a successful deployment of the game.

Limitations and Future Work

This paper provides a theoretical framework for understanding experiential learning with game-based approaches for business informatics curriculum. The findings of this paper are based on grounded theory. This paper employs the learner-centered theory that defines the learning experience in the 14 principles regarding cognition, motivation, assessment and social skills, which have been set as criteria for improving the learning experience of students. This has committed the work to an assumption based on learner-centered Framework.

The learning experience is a qualitative concept and can be influenced by many different contextual factors of which this study has reviewed a limited number. For example, if the learner-centered approach was not incorporated in the analysis of data, then some of the missing aspects may be absent. Therefore, researchers are encouraged to apply other learner-centered theories such as Bell and Kozlowski (2010) into the context of game-based learning and compare their results with what have been presented here.

Further limitation to this study relate to the lack of sufficient data. This study has used general course evaluation forms that are conducted by subject university as a primary source of data. The observations of the teaching team were also used; however, the observations were later evaluated through a Likert-scale survey of students. Therefore, researchers and practitioners are recommended to test out the results of this study in more populated data sets. This can provide comparisons to the results presented in this paper.

REFERENCES

All, A., Castellar, E. P. N., and Van Looy, J. 2015. "Towards a Conceptual Framework for Assessing the Effectiveness of Digital Game-Based Learning," *Computers & Education* (88), pp. 29–37.

AQF. 2013. "Australian Qualifications Framework," Other, , February 24. (http://www.aqf.edu.au/, accessed September 17, 2013).

Barr, R. B., and Tagg, J. 1995. "From Teaching to Learning—A New Paradigm for Undergraduate Education," *Change: The Magazine of Higher Learning* (27:6), pp. 12–26.

Baskerville, R., and Pries-Heje, J. 1999. "Grounded Action Research: A Method for Understanding IT in Practice," *Accounting, Management and Information Technologies* (9:1), pp. 1–23.

Beauchamp, G. 2017. "Factors Influencing Attitudes towards Information and Communication Technology (ICT) Amongst Undergraduates: An Empirical Study Conducted in Kuwait Higher Education Institutions (KHEIs)," *TOJET* (16:2).

Chalam, B. 2011. "Beergame." (http://scgames.bauer.uh.edu/, accessed March 24, 2013).

Corbin, J., and Strauss, A. 1990. "Basics of Qualitative Research: Grounded Theory Procedures and Techniques," *Basics of Qualitative Research: Grounded Theory Procedures and Techniques* (41).

Eguchi, A. 2017. "Learner-Centered Approach with Educational Robotics," in *Handbook of Research on Learner-Centered Pedagogy in Teacher Education and Professional Development*, IGI Global, pp. 350–372.

Fominykh, M., Leong, P., and Cartwright, B. 2017. "Role-Playing and Experiential Learning in a Professional Counseling Distance Course," in *EdMedia: World Conference on Educational Media and Technology*, Association for the Advancement of Computing in Education (AACE), pp. 1078–1090.

Frauenheim, E. 2004. "Students Saying No to Computer Science," *CNET News*.

Glaser, B. G., and Strauss, A. L. 2009. *The Discovery of Grounded Theory: Strategies for Qualitative Research*, Transaction Books.

Hainey, T., Connolly, T. M., Boyle, E. A., Wilson, A., and Razak, A. 2016. "A Systematic Literature Review of Games-Based Learning Empirical Evidence in Primary Education," *Computers & Education* (102), pp. 202–223.

Jan, M., Tan, E. M., and Chen, V. 2015. "Issues and Challenges of Enacting Game-Based Learning in Schools," in *New Media and Learning in the 21st Century*, Springer, pp. 67–76.

Jose, S., Patrick, P. G., and Moseley, C. 2017. "Experiential Learning Theory: The Importance of Outdoor Classrooms in Environmental Education," *International Journal of Science Education, Part B* (7:3), pp. 269–284.

Malu, K. F., and McNeal, K. 2017. "Creating Cartoons: A Learner-Centered Approach to Comprehending Texts.," in *English Teaching Forum* (Vol. 55), ERIC, pp. 28–31.

Motschnig, R., Sedlmair, M., Schröder, S., and Möller, T. 2016. "A Team-Approach to Putting Learner-Centered Principles to Practice in a Large Course on Human-Computer Interaction," in *Frontiers in Education Conference (FIE), 2016 IEEE*, IEEE, pp. 1–9.

Qian, M., and Clark, K. R. 2016. "Game-Based Learning and 21st Century Skills: A Review of Recent Research," *Computers in Human Behavior* (63), pp. 50–58.

Saraswat, A., Bach, J., Watson, W. D., Elliott, J. O., and Dominguez, E. P. 2017. "A Pilot Study Examining Experiential Learning vs Didactic Education of Abdominal Compartment Syndrome," *The American Journal of Surgery* (214:2), pp. 358–364.

Seethamraju, R., Leonard, J., and Razeed, A. 2006. *Development of Integrated Learning in Business Curriculum*, presented at the International Conference of HERDSA, Perth, Australia. (http://www.herdsa.org.au/wp-content/uploads/conference/2006/Seethamraju.pdf).

Soflano, M., Connolly, T. M., and Hainey, T. 2015. "An Application of Adaptive Games-Based Learning Based on Learning Style to Teach SQL," *Computers & Education* (86), pp. 192–211.

Sterman, J. 1984. *The Beer Game*. (www.lopn.net/files/The_Beer_Game_Website.doc).

Van Leeuwen, J., and Tanca, L. 2007. "Student Enrollment and Image of the Informatics Discipline," No. UU-CS-2007-024, Working Group Report for Informatics Europe, Netherlands: Department of Information and Computing Sciences, Faculty of Science, Utrecht University. (http://webdoc.sub.gwdg.de/ebook/serien/ah/UU-CS/2007-024.pdf).

Webber, K. L. 2012. "The Use of Learner-Centered Assessment in US Colleges and Universities," *Research in Higher Education*, pp. 1–28.