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IMMERSIVE LEARNING: USING A WEB-BASED LEARNING TOOL IN A PHD COURSE TO ENHANCE THE LEARNING EXPERIENCE

Samie Li Shang Ly* Concordia University, Montreal, Canada smie.vision@gmail.com
Raafat Saadé Concordia University, Montreal, Canada rsaade@concordia.ca
Danielle Morin Concordia University, Montreal, Canada danielle.morin@concordia.ca
*Corresponding author

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ABSTRACT

Aim/Purpose	Teaching and learning is no longer the same and the paradigm shift has not settled yet. Information technology (IT) and its worldwide use impacts student learning methods and associated pedagogical models.
Background	In this study we frame immersive learning as a method that we believe can be designed by pedagogical models such as experiential, constructivist, and collaborative elements. We also present a peer-to-peer interactive web based learning tool, designed and implemented in-house with immersive learning features.
Methodology	We conducted an exploratory research with a Ph.D course on "pedagogical methods" where 9 doctoral students were tasked to follow the peer-to-peer 3 phase process in their learning.
Contribution	We found the peer-to-peer does favor experiential, constructivist, collaborative learning, which contributes into the use of immersive learning as an important learning style for the future.
Findings	This study investigated different ways to measure students' collaboration, constructivism through their peer evaluation scores and performance in an immersive learning environment by taking the roles of teacher, evaluator, and learner.
Recommendations for Practitioners	An in-depth understanding of immersive learning methods allows the application of Experiential Immersive Learning (EIL) in various disciplines of professional training, which can increase performance and engagement.

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Recommendation for Researchers	It is necessary and advantageous for a researcher to view in-depth the process of students' learning, to have the ability to quantify, analyze each individual's contribution, and to observe via Information Technology the collaborative aspects of learning.
Impact on Society	By observing an effective methodology in learning, this allows us to understand how knowledge is created throughout different disciplines.
Future Research	Further studies should be made to adjust and polish our understanding of the peer-to-peer tool in order to gain a deeper understanding of customized learning.
Keywords	immersive learning, information technology, learning models, educational evolution

INTRODUCTION

In a changing world where digitalization and technology have and will continue to impact our everyday lives, education and training are two of the main foundational aspects where IT learning tools can serve educational institutions. The latest topics in education today build around new immersive learning environments, which usually entail 3 Dimensional graphics, computer games, and animation, as well as a whole range of elaborate and wide spread mobile devices of various sizes (that would suit all demographics and contexts) (Stefan, 2012). However, we question whether all technologies are suitable in bringing an immersive experience.

Ideally, the aim of learning is to genuinely engage and be totally absorbed in an activity where time is perceived to pass very fast (Saadé & Bahli, 2005). This cognitive state implies total immersion in the activity and has been shown to be conducive to and very effective for learning. The advent of Information Technology (IT) and its worldwide use impacted student learning styles and expectation for learning. Consequently, IT has also impacted learning methods and associated pedagogical models, which have evolved from basic unidirectional teacher-to-student instruction into dynamic IT supported and elaborate learning environments (Saadé, Nebebe, & Mak, 2011) – at least this is the promise. It is evident today, from the body of research, that more educators are experimenting with IT for teaching inside and outside the classroom, while at the same time, students are becoming more savvy and critical in assessing and using IT for their learning.

Rooted in the traditional classroom style(s), educators (as part of their profession) are expected to continuously seek teaching and learning improvement to engage all the senses and create more effective elements such as videos, animations and PowerPoints. However, it seems that classroom experiences continue to be dominated by non-interactive passive learning, especially at the PhD level. However, the`re is also a debate around the notion that not all immersive environments are created for learning. Some, for example, are simply to have fun and improve some tactile skills and strategic thinking and are not targeting the acquisition of knowledge per se. In that respect, researchers must be careful in addressing the knowledge (or subject matter) component of the immersive learning process and environment. It is exactly with this in mind that this article presents a link between immersive environment and knowledge acquisition.

In response to the need to utilize IT's potential and resources to enhance the learning environment, we considered in this article the concept of immersive learning and its fundamental elements necessary for the acquisition of knowledge. Our proposed methodology tests a web-based learning tool (that meets the immersive learning element) was inspired by past research on innovative technologies in immersive learning (Van Schaik, Martin, & Vallance, 2012). We will take an exploratory perspective allowing the improvement of our tools. The learning platform was used in a Ph.D class on "Pedagogical Methods". We describe the whole process and present the results. We conclude by elaborating on the potential of such innovative learning tools that can be used in-class or online.

LITERATURE REVIEW

We provide herein a literature review that we conducted as we scan the body of knowledge and seek to understand various styles of learning (that can be used to construct immersive learning activities) such as experiential, constructivist, and collaborative, which we believe, together in some combination, can provide interesting and effective opportunities for IT to create and engage students in an immersive learning environment. We examine various literature introducing advanced technological inventions of virtual reality used in an immersive learning experience to then blend the importance of learning styles with technology and suggest future research ideas to contribute to the theory.

Previous research indicates active learning strategies are more effective than traditional passive learning styles (Inks, & Avila, 2008; Saadé, Tan, & Kira, 2008). As education is relevant for institutions such as elementary, secondary, university, and higher education, education is also relevant in training within the professional world (such as professional selling, manufacturing services, entrepreneurship) where new course delivery methods (such as hybrid, web-based courses) are used based on cost, time effectiveness, quality of the learning experience, and individual learning styles and needs. As authors Auster and Wylie (2006) developed a systematic approach to active learning, they included four interrelated dimensions of the teaching process consisting of context setting, class preparation, class delivery, and continuous improvement.

Immersive learning, which can be considered as an active learning strategy, is complemented by various learning styles. Auster and Wylie's (2006) context setting involves the establishment of an atmosphere for learning that facilitates student interaction and engagement. Referring to Inks and Avila (2008), engagement relates to the quality and effectiveness of the learning experience where people learn better when they are fully engaged. It requires students to participate in discussions, reflect on their thoughts, solve problems, and be present in activities by which the learner is required to go through a cognitive process of new information presented. An effective, high quality context atmosphere requires a lot of monetary investment, by which researchers use technologies such as virtual realities with gamification and strategies to create an enticing environment for students to immerse in and learn. Not only should the environment be attractive but accessible to all those who wish to learn at low cost, otherwise true experiential learning may incur a high cost such as travelling expenses, extended time for readiness to experience, or investment in risky efforts which may not result in the experience intended.

At the K-12 levels, the creation of content for learning, and the ability for educators to represent abstract content such as physics and mathematics in a motivated environment contributes to increasing class involvement (Bobbitt, Inks, Kemp, & Mayo, 2000; Young, 2005), critical thinking (Klebba & Hamilton, 2007; Roy, 2005; Sautter, 2007), and greater retention of subject content, which also increases the confidence of the student involved. In terms of class delivery, from PowerPoint to blackboard and chalk, the world has evolved into greater graphical delivery content such as 3 dimensional virtual realities which provoke a higher interaction of the content with the student using behavioral elements such as tactile, vision, and auditory senses.

With respect to learning styles, it is worth noting that traditional learning styles create hurdles in customizing learning content for each student as their behaviors differ and their retention of the information varies from one person to another. With the start of web-based interactive content, allowing students to learn at their own pace, students and teachers can receive feedback and act in seeking continuous improvement such as coming back to a lecture or reviewing unclear content. Many learning management systems today monitor improvements on a regular basis.

Considering the above discussion, defining "immersive learning" can be problematic as it attaches itself to experiential, constructivist, and collaborative elements found in various activities designed to engage the participant. The literature always refers to "immersive learning" as it relates to a specific context and in the presence and facilitation of some form of information technology. In this re-

search study, our literature review revealed that there are three primary perspectives at which "immersive learning" is utilized: in an experiential environment, through a constructivist method, and via active collaboration.

Experiential Immersive Learning (EIL) is represented by activities that allow students to immerse themselves in an artificially constructed world (virtual world) that may resemble reality. As Johnson and Levine (2008) describe, virtual worlds such as Second Life allow students to become part of a constructed world, interact with the virtual environment, and learn from simulated experiences automatically created or arising based on a specific series of interactions (Milgram, Takemura, Ustimi, & Kishino, 1994; Stefan, 2012). Students interactions in EIL with elements such as people, activities, quests, tasks, objects and other simulated artifacts present an opportunity that may be hard to create in the real world due to expenses and/or risks (Inks & Avila 2008). For example, students can visit a Nano scale environment in 3 dimensions to examine a photon and travel through a lesson in particles of physics delivered by an avatar of Einstein (Johnson & Levine 2008). This experience provides students with a different view of the subject matter, both memorable and illuminating, that the traditional classroom was not able to offer. It is also an environment where students can manipulate the parameters of their studies by creating visual effects in real time. EIL is very rewarding and engaging as immerging technologies including virtual reality and collaborative/social systems are now giving students and institutions access to a cost effective customized learning platform solutions (North, 2014).

Using the *constructivist learning method*, students are provided with opportunities to learn at their own pace. A constructivist online experience can be created today by customizing an environment designed by difficulty levels taking into consideration a student's prior knowledge and questioning these students on their unique misconceptions of a subject matter. To that effect, constructivism entails an interesting reflective and introspective element to learning, which entails the processing of knowledge that needs to be gained and assimilated. In an environment where instructors have the ability to create a personal connection, they can engage students in the reflective activities by observation and test them on abstract conceptualization of a specific subject matter, whereby knowledge contained within the activity may be guided or scafolded. As a method of customization, information technologies allow educators to manage student's opinions, contributions, behavior, motion, etc., which may then update the environment in real time (Biocca & Delaney, 1995). In constructivist-based online learning tools, teachers can monitor the learning process of their students. Students can be allowed to be autonomous in their learning such that they can freely travel in the environment, interact with other students, and acquire information of interest while teachers can receive feedback on their students conscious and unconscious learning progress (Fernandes, Raja, & Eyre, 2003).

Social or Collaborative learning (an activity that is very popular today with all the social networking websites) allows students to capitalize on the opportunity to share and learn from each other. Interactivity plays a crucial role in the world of immersive learning; as Kalay (2004) expressed, virtual surroundings allow group learning, similar to a class physical experience, where they are aware of the social process of learning and are affected by the presence and behavior of their peers. Technologies facilitate spatial and process visualization, which allows students to discover time sensitive and cultural backgrounds through graphical reconstructions (Stefan, 2012).

To that effect, collaborative online learning tools become an asset for individuals to create working spaces for distant learners where they can meet, network, and exchange experiences and knowledge (Stefan, 2012). The network is from student to student but also student to teacher as well as teacher-to-teacher in a global setting (North, 2014).

Immersive learning that draws on IT support, social networking, and gamification rely heavily on technological and process-driven advances that are rich in user interfaces, represent realistic situations, represent complex pedagogical processes and the creation of an environment where students can engage and immerse themselves into experiences that foster learning.

METHODOLOGY

THE CONTEXT

Our methodology in testing this learning tool came from an exploratory perspective where our goal was to evaluate students' engagement and experience level at multiple levels of academic learning. Many recent research studies have taken an interest in immersive learning tools mainly Dede (2012), Van Schaik et al (2012), and Dawley and Dede (2014). Our methodology in using both quantitative and qualitative observations follows previous examples.

A peer-to-peer (P2P) learning tool is a web-based interactive system used for student learning and assessment. It facilitates a process of knowledge creation, knowledge evaluation and synthesis, and assessment of knowledge gained (learned). The P2P tool was used in a PhD level course (Pedagogical Methods), in the John Molson School of Business, Concordia University, Montreal, Quebec, Canada. This course is mandatory, for PhD students to learn how to become skillful, thoughtful, and confident instructors in any teaching and learning setting. The course tasks aim to enable the students to design effective courses that they would be required to teach, to help them acquire deep approaches to learning, and to improve their teaching effectiveness.

Readings and reference material that draw on seminal work in educational theory and practice are discussed and students learn to provide a conceptual framework to construct and refine pedagogical choices for different audiences. At a theoretical level, learning of the course content (primarily behaviorism, cognitivism, and constructivism) revolves on the engagement of students at all six bloom levels. The bloom taxonomy, created by Benjamin Bloom consists of stages of learning where an individual gradually improves their understand through the steps of remembering, understanding, applying, analyzing, evaluating, and creating (Bloom, Engelhart, Furst, Hill, & Krathwohl, 1956)

Classes are task-oriented. Tasks emphasize collaboration, reflection, and action. By the end of the course students are expected to have developed a Teaching Philosophy Statement, Course Outline, taught in a real class setting, and learned about signature pedagogies that have a high educational impact. Of great importance is that students engage in discussion about exploring and reflecting on their personality traits and teaching styles with association to teaching and pedagogical methods that would be appropriately aligned. The learning goals of the course are:

- Articulate students' own teaching philosophy and elements of a teaching strategy statement,
- Evaluate good practices in teaching and qualities of highly effective teachers in students' respective area of specialization,
- Lead discussions and teach in ways that promote the conceptual knowledge and follow effective practice,
- Apply basic instructional design elements to construct a course,
- Experience active learning techniques, and enhance communication, presentation skills, and drama as means of connecting with the audience.

THE PROCESS

The P2P tool involves three phases that encourage the active participation of students. *Phase 1* involves the system presenting the students with a peer-refereed article (in the present case, an article published in an educational psychology journal) related to pedagogy. Students are given a specific amount of time to read the article. In the present case, the subject matter of the article has already been discussed in class, in previous lectures. When ready, the students are required to submit a predetermined number of questions. Students are instructed to create questions whose answers can be found in the article and should be theoretical in nature. When all students submit their questions, this phase is closed. *Phase 2* starts with the P2P tool randomly providing each student with a random set of predetermined number of questions generated by their peers in phase 1, for evaluation. The P2P

tool ensures that students do not get their own questions for evaluation and only their peer's questions. The number of questions each student receives is calculated by the P2P tool and is based on the number of evaluations per question set by the teacher. In other words, the teacher decides on the number of evaluations that need to be done to each question to determine a consensus or agreement on the evaluation variable in question. With each student rating each other's questions according to two variables, namely their perception of the level of difficulty each question possesses and level of quality, the P2P will end up containing a significant number of evaluated questions that represent a body of knowledge to be learned. Therefore, if a question is not clear or even has a typing error or is grammatically incorrect, the students may rate it as low quality. The scales for both difficulty and quality are low, moderate and high.

After all the questions have been assessed, *Phase 3* is opened. While the students take a small break, the teacher can create one or more tests. In this phase, the pool of student generated questions will then be used to create online tests/quizzes. The teacher has the option to create tests from different groups of students and assign it to other groups of students. We would like to note that the student profiles include their ethnic background and gender. This is important because in this phase, the professor can create a test by specifying from which sub-pool of questions (those generated by male/female and/or specific ethnic background) to select the test, and specifying which sub-group of students (gender and ethnic background) is to take the test.

During this P2P learning process, students are encouraged to provide high quality questions by receiving additional marks should their questions be chosen to appear in the quiz. The questions are randomized such that each student receives different questions with an equal amount of easy, moderate, and difficult level questions.

Immersive Elements of the P2P Tool

The emphasis of the P2P learning tool on student-centered teaching, where the student is responsible for his/her own construction of knowledge, seems to be reflected well in this tool. For example, students must develop their own questions that they then submit for peer rating. To be able to formulate questions, students must have a deeper understanding of the subject matter. In addition, to be able to determine or rate the submitted questions, students must also show a deeper understanding of the subject matter. It has been said that the best way to ensure that you understand a topic is to try to teach it to someone else. In order to do this, one needs to be able to formulate questions.

The P2P learning tool includes elements that are experiential, constructivist, and collaborative. These elements have been elaborated in the literature review section above. In this section, we map those elements to the P2P components / processes / phases. The following immersive elements are mapped to the P2P tools keeping in mind that students while using the tool are playing the roles of the teacher, evaluator, and learner (TEL), depending on the time and place (phases and tasks) they are engaged in.

Experiential:

- Students become part of the TEL constructed world, interacting via the tool environment and learn from simulated experiences as their tasks change depending on the role they are engaged in – teacher, evaluator, learner.
- Students interact with other students, tasks, documents, websites, articles, and knowledge artifacts managed by the tool.
- Students can manipulate the parameters of the knowledge creation process by viewing other student's created knowledge and provide assessment of that knowledge.

This experience of creating knowledge, evaluating that knowledge, and assessing their learning provides students with a different view of the subject matter, as well as insight into other stu-

dents' thinking of the same subject matter that are both more memorable and illuminating than traditional methods which are not able to offer this.

Constructivist:

- The P2P activity can be done virtually or in the classroom. In either case, enough time can be given to students to complete the tasks and learn at their own pace.
- An environment designed in consideration of a student's prior knowledge and questioning these students on their level of understanding of the subject matter at hand.
- Includes reflective and introspective element to their learning, which occurs during the P2P process and entails the processing of knowledge that needs to be gained and assimilated.
- The instructor can create a personal connection by engaging students in the reflective activities and test them on the subject matter.
- As part of customization, educators are able to manage students' contributions, behavior, and knowledge acquisition, which updates the environment (in phase 2 for example) in real time.
- Teachers can monitor the learning process of their students by seeing their contributions in each phase in real time, and in the case of a classroom setting, the teacher can interact with the students and provide feedback in real time.

According to Hoy, Davis, and Anderman (2013), constructivists argue that learning needs to be looked at from the student's perspective. Thus if the questions are coming from the students, then they are the ones asking the questions that they find pertinent to their learning process. This is another indication of how this tool is based in the constructivism theory of learning.

Furthermore, constructivists argued that letting students direct the questioning and discussion that takes place in the classroom would result in more meaningful learning from the students' perspectives. In this case, the classroom may be online and the social ties necessary for learning to take place per this view are virtual, however, the creating of the questions and the rating of each other's work, still makes for meaningful learning for the students.

Collaborative learning:

- Students capitalize on the opportunity to share and learn from each other by evaluating the knowledge created by others (phase 2) and reflecting on the evaluation of others on their own work (phase 3).
- Students are aware of the process of learning, the role they are playing in every phase, and are affected by the presence and behavior of their peers.
- The P2P facilitates the process of visualizing the student's role and tasks to be done in each phase, which allows them to discover knowledge sensitive backgrounds.

In summary, this teaching tool seems to be supported by the constructivist and cognitivist theory of learning since it allows students to direct their own learning based on their own integration of knowledge and their ability to direct the questioning.

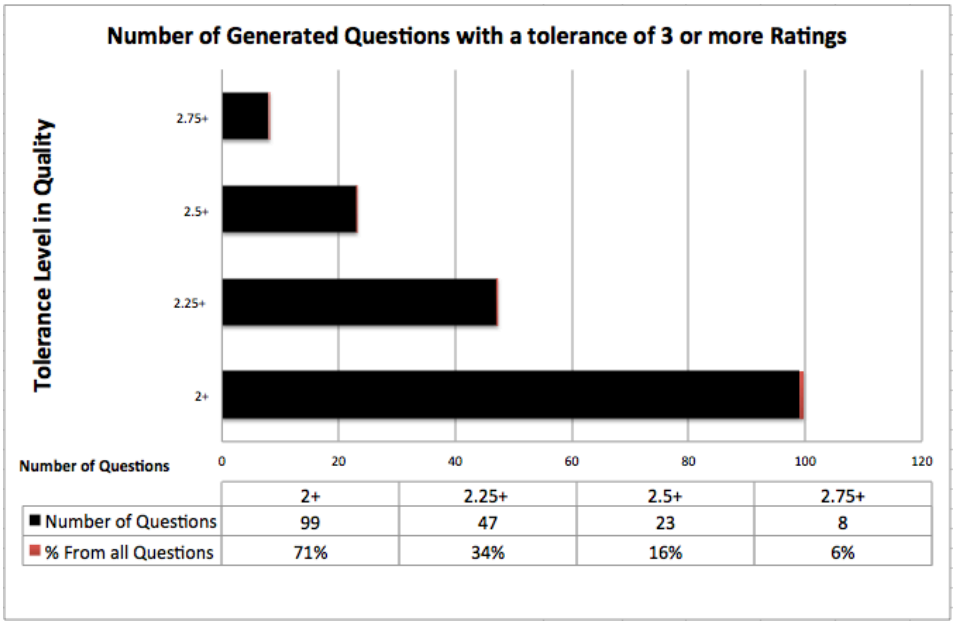
RESULTS & DISCUSSION

The use of the P2P learning tool generates data on objective performances and knowledge acquisition measurements such as quality of test questions generated and time of activity. The results used for analysis entail the outputs from each phase, primarily the questions, questions level of difficulty, questions level of quality, test characteristics, and student test performance. In this section, we present the analysis of the P2P outputs and we also provide further insight on the student engagement and assessment using the item response theory.

Peer Evaluations of Questions Generated

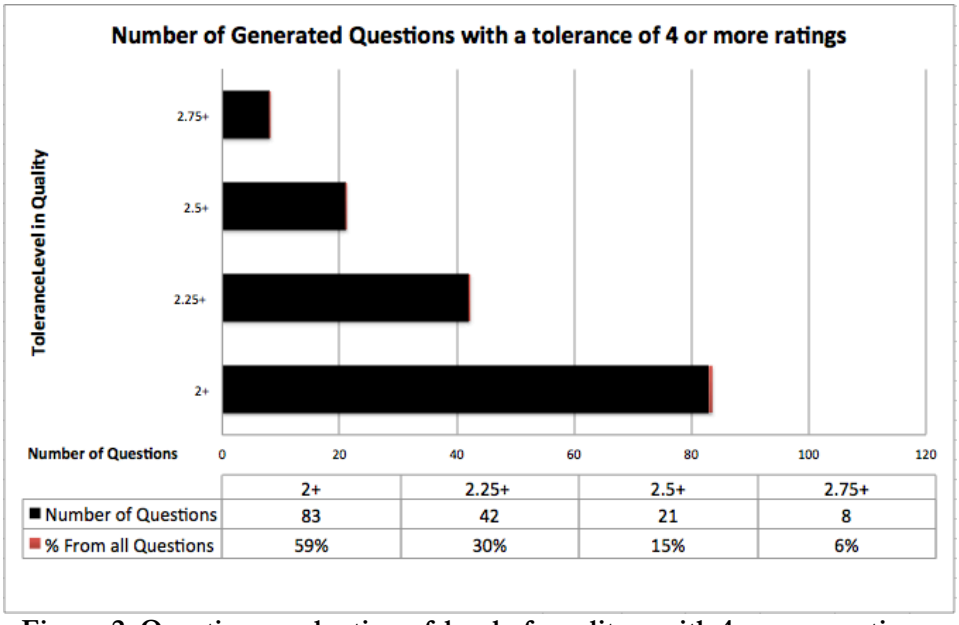
This section of results provides a greater understanding of the eco-system created by the tool for the students. We gain a better understanding on the quality of questions created by students. These questions allow us to define the styles of learning within an IT tool and validate its usefulness in learning.

The class with 15 students generated 140 questions in phase 1, and in phase 2 they were asked to assess 25 questions. In this case, each question was assessed by 4 students. The mean level of quality (Figures 1, 2, and 3) and difficulty (Figures 4, 5, and 6) for each of the 140 questions have been organized in frequency diagrams shown below, for tolerance levels 3 or more, 4 or more and 5 or more, respectively.



	2+	2.25+	2.5+	2.75+
Number of Questions	99	47	23	8
% From all Questions	71%	34%	16%	6%

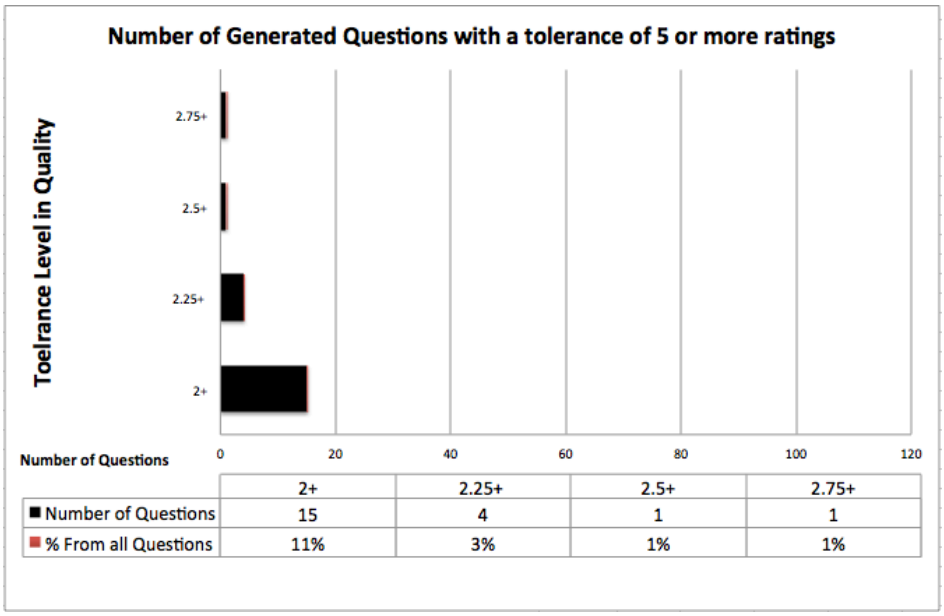
Figure 1. Questions evaluation of level of quality – with 3 or more ratings.



	2+	2.25+	2.5+	2.75+
Number of Questions	83	42	21	8
% From all Questions	59%	30%	15%	6%

Figure 2. Questions evaluation of level of quality – with 4 or more ratings.

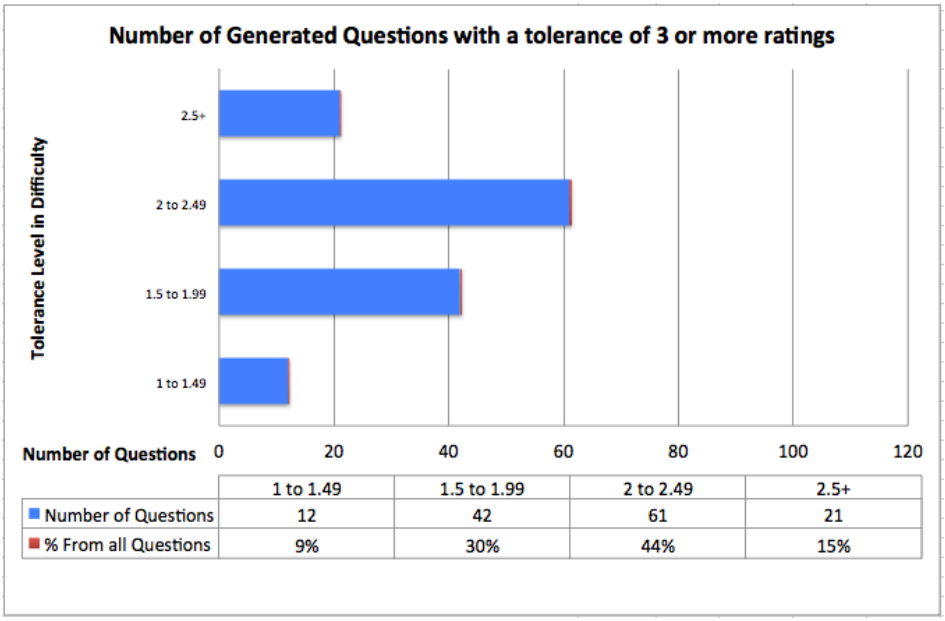
Results indicate that the mean level of quality (Figures 1, 2, and 3) of the total number of questions generated is 2 (on a scale from 1 to 3) with a standard deviation of 0.4. The modal class is the level from 2.0 to less than 2.5 with a 56% frequency.



	2+	2.25+	2.5+	2.75+
Number of Questions	15	4	1	1
% From all Questions	11%	3%	1%	1%

Figure 3. Questions evaluation of level of quality – with 5 or more ratings.

Moreover, results indicate that the mean level of generated questions difficulty (Figures 4, 5, and 6) is 2 (on a scale of 1 to 3) with a standard deviation of 0.4. The modal class is the level from 2.0 to less than 2.5 with a 46% frequency



	1 to 1.49	1.5 to 1.99	2 to 2.49	2.5+
Number of Questions	12	42	61	21
% From all Questions	9%	30%	44%	15%

Figure 4. Questions evaluation of level of difficulty – with 3 or more ratings.

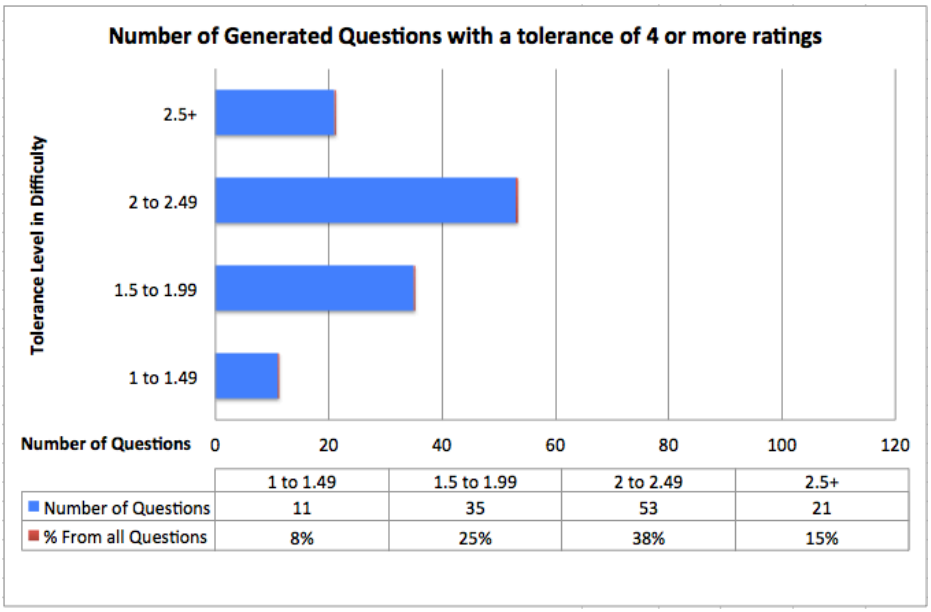


Figure 5 Questions evaluation of level of difficulty – with 4 or more ratings.

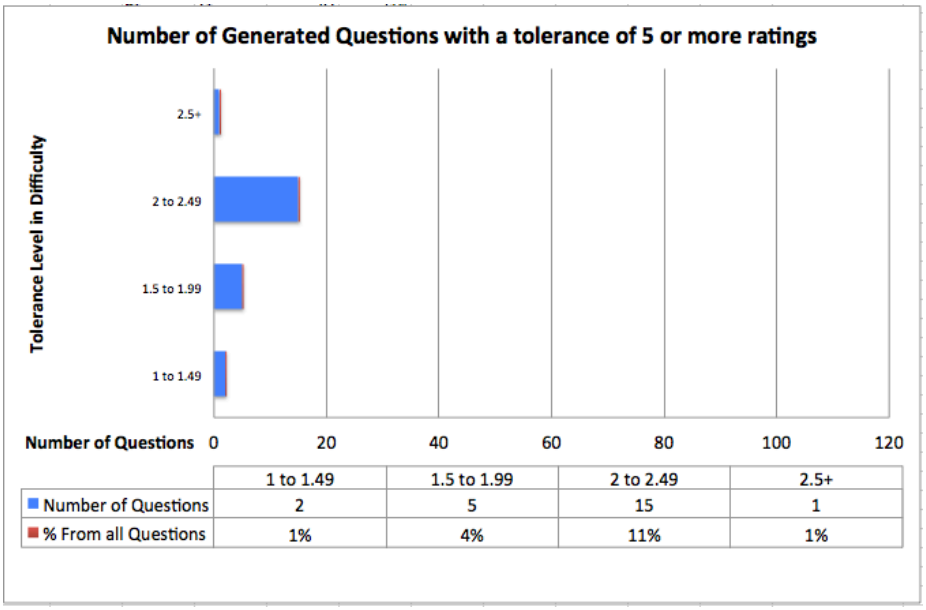


Figure 6 Questions evaluation of level of difficulty – with 5 or more ratings.

In an attempt to better understand the quality to difficulty relationship of total number of questions generated, we performed a simple correlation analysis between them. We found that the coefficient of correlation between the Level of Difficulty and the Level of Quality is 0.309, which means that as the level of difficulty increases, the level of the quality of the question also increases. This is actually a desirable effect, however, more studies need to done to confirm the validity of this finding or rule out secondary perceptions effects.

Test Characteristics & Results

Figures 7and 8 below present the level of difficulty and level of quality for tests generated by the professor, in Phase 3, respectively. The questions are presented in the appendix at the end of the article. In the appendix, the last column to the right represents the total number of ranking for each question (TR). We present this table so the reader can assess the questions generated. These questions were not edited by the professor, for the purpose of simulating a completely peer-to-peer driven activity with no professor intervention. The entire idea behind the P2P tool is based on the premise that the professor does not intervene in the knowledge creation, acquisition, and assessment process and that self-directed peer-to-peer learning is possible. All these questions were multiple choice.

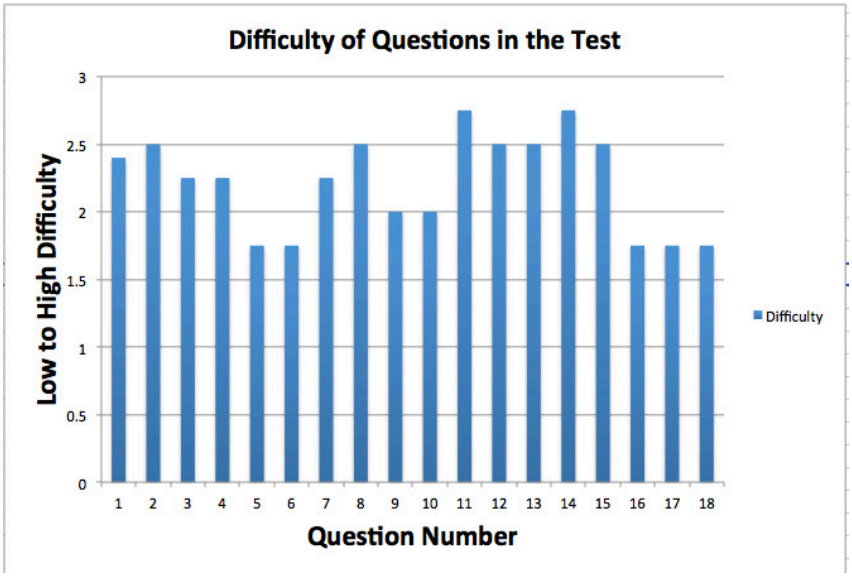


Figure 7. Questions evaluation of level of quality – with 5 or more ratings.

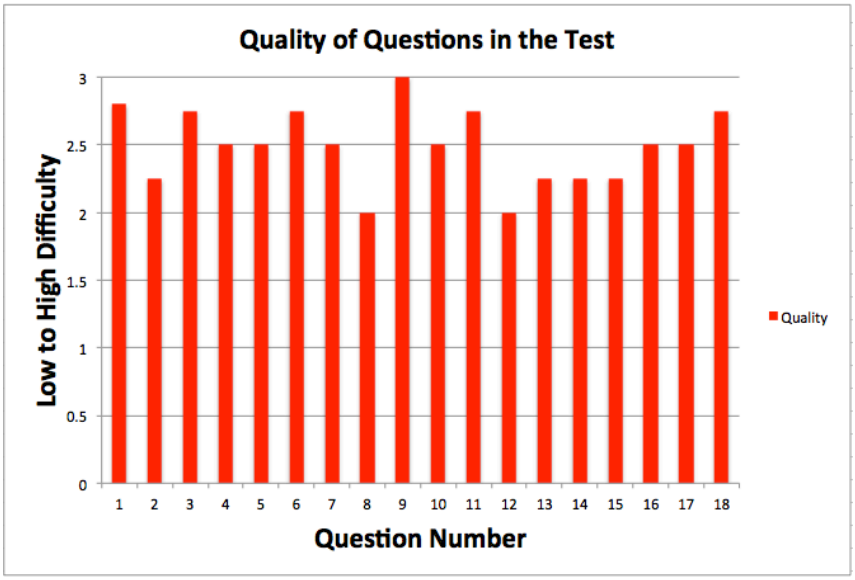


Figure 8. Questions evaluation of level of quality – with 5 or more ratings.

It is evident from Figures 7 and 8 that the P2P tool was able to generate questions whereby questions' difficulty and quality are well distributed. In other words, there is a clear benchmark for quality, which is at level 2, such that all questions in the test were of high quality. Moreover, with respect to the level of difficulty, the number of questions selected from the pool at levels 1.75, 2.0, 2.25, 2.5, and 2.75 were 5, 2, 3, 6, and 2, respectively. These are favorable results of the P2P tool which was able to generate a test with questions at 5 different levels of difficulty while maintaining a high level of quality.

Table 1 presents the results of the test showing the time taken by every student to complete the test and corresponding score, where we explore possible relationship between score and duration. Out of the 15 students, only 9 participated since this was a pilot, and the activity was not mandatory.

Table 1. Student test results.

Student	Duration (Min)	Duration (hrs)	Score, %
1	28	0.5	93
2	41	0.7	80
3	42	0.7	77
4	73	1.2	80
5	245	4.1	70
6	695	11.6	80
7	1614	26.9	83
8	5471	91.2	80
9	5889	98.1	73

It is interesting to note that the duration for doing the test (which was open) ranged from 28 minutes to 98 hours (or 4 days). Since the test was open and the test included questions from one article in educational psychology, Table 1results provide insight on how students strategized to do the test. Those who did the test within one hour or so may have studied the article first (the professor's original intention) then simply did the test. On the other hand, students who took more time to complete the test were referring to the article as they answered each question. Students who did the test over a duration of days, may have done some questions, kept the screen open then came back to complete other questions. What is interesting, is that as we go down the records in Table 1 from student 1 to student 9, we observe a tendency of decreasing performance. The following two figures attempt to assess that.

To analyze performance, we split the 9 students into two groups: group A and group B where group A (Figure 9) are those who did the test within an hour implying that these student studied first then did the test back-to-back; while group B (Figure 10) are those who possibly did the questions while referring to the article and where they may have stopped and come back to complete another set of questions at a later time.

Both figures clearly show that students, who take more time to complete an exam, also seem to score less. This phenomenon has been previously observed and reported. This trend is significant for group A students with R^2 close to 96%. (We acknowledge that 3 cases do not make a conclusion, but the results point to interesting phenomenon which begs further research.) The contrary is found for group B students: The slope of the line fit (change in score with increasing duration) is not significant with R^2 close to 38%. In other words, no matter how long a student keeps reviewing the article to figure out the best answer, the result or selection of the answer would be the same. This result alludes to the fact that the students' understanding of the article (subject matter) and synthesis of knowledge contained (in the present context of course) has plateaued. Any increase in performance

would require the intervention of the professor via other activities. So, for example, if this article was the discussed in class in-depth and students were asked to take the test again, the overall performance of the group would be expected to increase. On the other hand, students in group B may have not been motivated to participate in the activity resulting in such performance outcome.

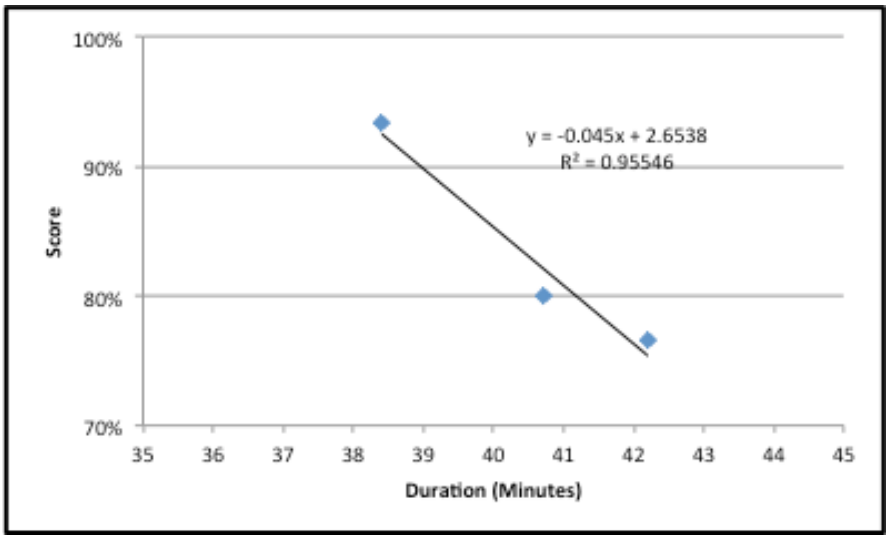


Figure 9. Performance trend of type A students.

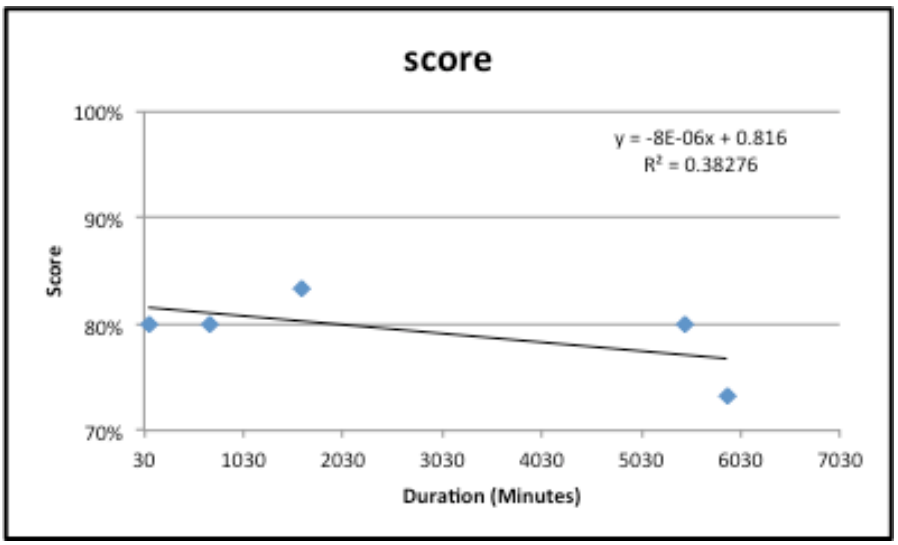


Figure 10. Performance trend of type B students.

Item Response Theory Analysis

In this section, we attempted to understand the students' performance at a deeper level, which relates to their cohort. The advantages in utilizing an IT tool allows us to see the progression and identify students ability to answer questions, but also their ability to be critical about questions and options available to them.

Due to the context of this study, we identify the item response theory (IRT) (Santor & Ramsay, 1998) as an appropriate method of analysis. In this sub-section, we present an analysis of the student test

data using the IRT. In the present context, the sample is too small to perform standard statistical analysis such as regression and correlations. Our goal is to understand the impact of the P2P tool as an immersive environment, on the learning of the student vis-a-vis their knowledge processing. The IRT seems to be a possible and justifiable method of analysis to meet this goal.

The method of IRT analyzes specifically each question answered by the students, instead of looking at their total score which represents the total aggregated assessment of their knowledge but lacks insight into their ability to process the knowledge to be gained. The analysis allows us to look at expected answers providing information for future examinations of the same type. In order to create results, we used Testgraf to generate responses. Testgraf is software created by Professor Jim Ramsay from Mcgill University as an aid to the development, evaluation and the use of multiple-choice examinations as well as for psychological scales and questionnaires (Ramsay, 2000).

We select two students with different test scores for IRT analysis. Student # 7 scored 15/18 (83.33%). Figure 11 shows the relative credibility curve, which illustrates the student's actual and expected scores. On the x – axis is the actual score of the student (vertical straight line), on the y-axis, is the credibility factor of the student, if this student were to retake another exam of the same type. Credibility is a measure of a student's true proficiency level. Based on the student's option choices in the test, wrong and right, the credibility curve shows the range in which the students will perform if a similar test is taken. When the curve reaches credibility of 1, the value of the test grade is the maximum likelihood estimate of the student's proficiency.

In comparison with the rest of the class, this student ranked in the higher 95% of the class. The corresponding credibility factor also shows that if the student were to retake a test of the same type, this student's performance would range from 10 to 14. Since its maximum likelihood approaches the credibility of 1, it means this student's performance is consistent.

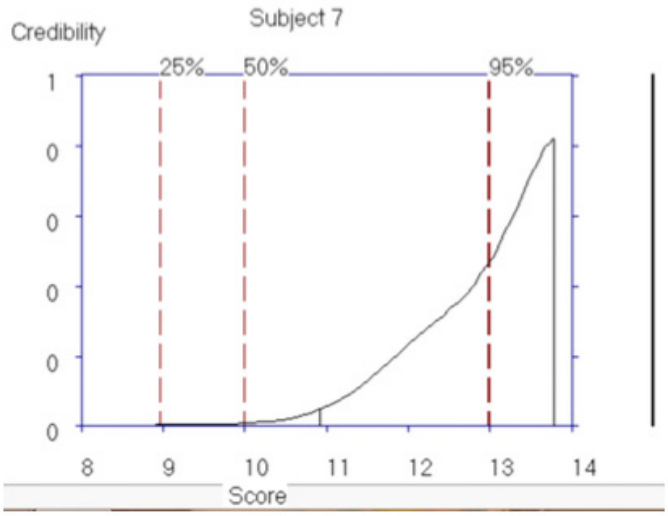


Figure 11. Analysis of student 7.

In comparison, Student # 8 (see Figure 12) scored 10/18 (70%) ranking him a little lower than 50% of the class. His expected score would range from 9 to 13, although looking at his maximum likelihood estimate of proficiency, his performance may fluctuate and show less consistency if a similar examination is taken.

Inputting the sequential question answers of the students into Testgraf, we are able to generate an analysis per question item, per student and an overview of the test performance. IRT allows test

evaluators to check for discrimination within an exam, such that whether a question is differentiating a strong student from the weaker students and whether the questions are balanced in terms of difficulty level.

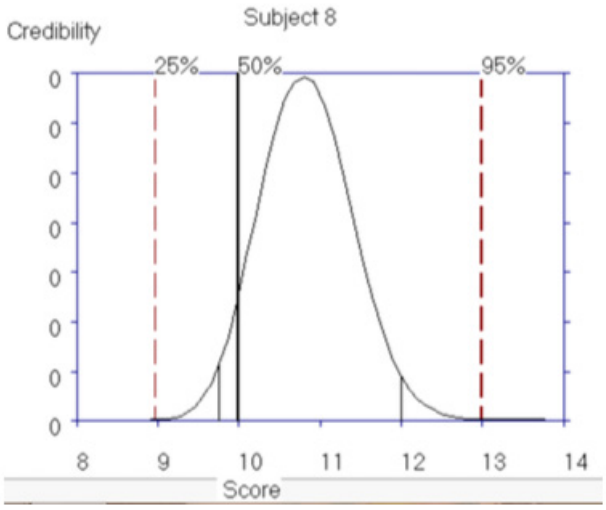


Figure 12. Analysis of student 8.

The IRT can also provide us with insight into the question's performance as it relates to the group of students by analyzing the standard error of questions (answered right or wrong) as they relate to student's performance. Figure 13 shows the standard error between right (green line) and wrong (red line) answers obtained from the test results of all the students. A large fluctuation (variation) exists for students who scored in the 50th to 85th percentile, meaning their wrong answers were not always the same, while students who scored over 95th, or below 25th percentile, have a lower fluctuation in their performance as represented by their scores. In other words, for students who excel or do poorly, the difference in their answers as compared with each other varies little.

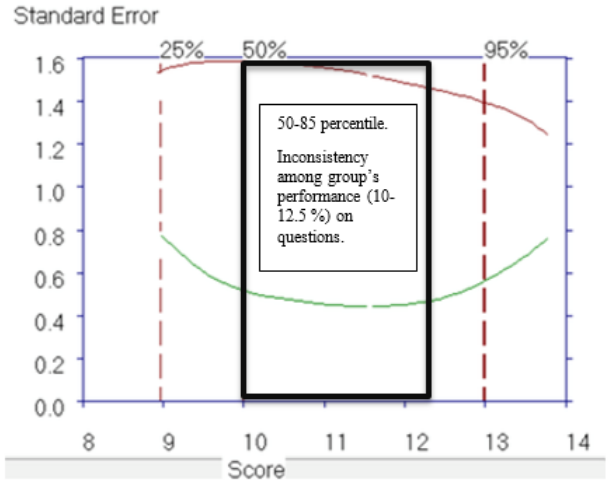


Figure 13. Standard error between right and wrong.

FUTURE RESEARCH & CONCLUSIONS

Throughout the literature, immersive learning showcases many advantages to improve current learning, not only do virtual realities allow possibilities of visualizing environment that a human cannot see in real life, virtual realities create an interactive nature which allows knowledge to be spread quick-

ly, effectively, and globally. Through the four dimensions of the teaching process (context setting, class preparation, class delivery and continuous improvement) and the three styles of learning (Experiential, Constructivist, Collaborative), these elements all contribute into the use of virtual realities as tools to utilize immersive learning as an upcoming, important learning style. In this proposal, as the literature on immersive learning is still at its beginning, many perspectives can be explored as we suggest further investigation into the use of human senses such as tactile, olfactory, auditory, visual, and gustatory as an integration to creating immersive learning styles.

At the moment, virtual realities only touch on tactile, auditory, and visual senses; however, based on branding literature and psychology research of senses, olfactory is one of the most powerful senses in creating memories (Anggie & Haryanto, 2011) at the conscious and unconscious level. The olfactory sense combined with the other senses (tactile, auditory, visual, gustatory) creates an experience for students to immerse into a learning environment. In addition, gustatory sense compliments all other senses as the smell influences the taste perception (Krishna, Morrin, & Sayin, 2014), which in turn influences the perception of an object, an environment, and a product. To support this proposition, Sumners, Reiff, and Weber (2008) have shown the relevance of using more modalities in learning styles to make the process more effective through enhancing engagement.

While Nokia has presented a multi-sensory communications device (Hultén 2011), similar branding strategies can be created towards education as the cognitive, behavioral processes are the same in gaining attention and creating retention. The popularity and necessity of virtual realities will become the default method for representing problems (Jonassen 1999). This invention, with multiple assets, such as having a collaborative, interactive nature, can be enhanced to multiple modalities, multi-sensory learning styles. This platform also adds freedom and decision making potential (Stefan, 2012) and representation of both abstract and concepts material, while allowing individuals to have a presence (Dickey 2003) in a world they could have never imagined existed in a cost effective, high quality, and motivating environment.

In the present study, we aimed at creating an innovative pedagogical method that utilizes IT and the web to help engage students in different ways. The resulting P2P learning tool design process can be linked to the constructivist and cognitivist approaches and provides a wide range of learning opportunities by changing the configuration setup. Through these combinations, the tool allows students to be immersed in the activity of capturing and synthesizing relevant information.

We presented herein a pilot study using the P2P learning tool and executed in a PhD class. The results were interesting as they revealed a number of insights namely:

- That students engaged with each other (~constructivism)
- That students engaged with subject matter (~cognitivism)
- That spending more time on a test is not a guarantee to perform better
- The P2P learning tool
    - can be very effective
    - has an immersive learning element in its design and process
    - can be utilized for learning and assessment at the same time

Our contribution in this paper sheds light on a collaborative learning tool tested at a doctoral level classroom, which is indicative of future professors' proficiency in creating quality questions. In addition, this tool incorporates and acknowledges past research on experiential, constructivism and collaborative learning as well as immersive features. This study takes the field of innovative technologies in learning one step forward in understanding useful technologies in education that serve knowledge acquisition.

REFERENCES

Anggie, C., & Haryanto, J. O. (2011). Analysis of the effect of olfactory, approach behavior, and experiential marketing toward purchase intention. *Gadjah Mada International Journal of Business, 13,* 85-101.

Auster, E. R., & Wylie, K. K. (2006). Creating active learning in the classroom: A systematic approach. *Journal of Management Education, 30,* 333–353. doi: 10.1177/1052562905283346

Biocca, F., & Delaney, B. (1995). Immersive virtual reality technology. In F. Biocca & M. R. Levy (Eds.), *Communication in the age of virtual reality* (pp. 57–124). Hillsdale, NJ: Lawrence Erlbaum Associates.

Bobbitt, L. M., Inks, S. A., Kemp, K. J., & Mayo, D. T. (2000). Integrating marketing courses to enhance team-based experiential learning. *Journal of Marketing Education, 22*(1), 15-24. doi:10.1177/0273475300221003

Bloom, B. S., Engelhart, M. D., Furst, E. J., Hill, W. H., & Krathwohl, D. R. (1956). Taxonomy of educational objectives, handbook I: The cognitive domain.

Dawley, L., & Dede, C. (2014). Situated learning in virtual worlds and immersive simulations. In *Handbook of research on educational communications and technology* (pp. 723-734). Springer New York.

Dede, C. (2012) Customisation in immersive learning environments: Implications for digital teaching platforms. In C. Dede & J. Richards, (Eds.), *Digital teaching platforms Customizing classroom learning for each student* (pp. 282-297. New York: Teacher's College Press.

Dickey, M. (2003). Teaching in 3D: Pedagogical affordances and constraints of 3D Virtual Worlds for Synchronous Distance Learning. *Distance Education, 24*(1), 105-121.

Fernandes, K. J., Raja, V. H., & Eyre, J. (2003). Immersive learning system for manufacturing industries. *Computers in Industry, 51*(1), 31–40. doi: 10.1016/S0166-3615(03)00027-7

Hoy, A. W., Davis, H. A., &Anderman, E. M. (2013). Theories of learning and teaching in TIP. *Theory into Practice, 52*(sup1), 9-21.

Hultén, B. (2011). Sensory marketing: The multi-sensory brand-experience concept. *European Business Review, 23*(3), 256–73. doi: 10.1108/09555341111130245

Inks, S. A., & Avila, R. A. (2008). Preparing the next generation of sales professionals through social, experiential, and immersive learning experiences. *Journal for Advancement of Marketing Education, 13*(4), 47–55. Retrieved from http://www.mmaglobal.org/JAME-Archive/JAME-Winter-2008/JAMEWinter2008v.13p.47-55.pdf

Johnson, L. F., &. Levine, A. H. (2008). Virtual worlds: Inherently immersive, highly social learning spaces. *Theory into Practice, 47*(2), 161–710. doi: 10.1080/00405840801992397

Jonassen, D. (1999). Designing constructivist learning environments. In C. M. Reigeluth (Ed.). (2013). *Instructional-design theories and models: A new paradigm of instructional theory* (Vol. 2) (pp. 215–239). Routledge.

Kalay, Y E. (2004). Virtual learning environments. *Journal of Information Technology in Construction (ITcon), 9,* 195–207. Retrieved from http://www.itcon.org/paper/2004/13

Klebba, J. M., & Hamilton, J. G. (2007). Structured case analysis: Developing critical thinking skills in a marketing case course. *Journal of Marketing Education, 29*(2), 132-139. doi: 10.1177/0273475307302015

Krishna, A., Morrin, M., &Sayin, E. (2014). Smellizing cookies and salivating: A focus on olfactory imagery. *Journal of Consumer Research, 41*(1), 18–34. doi: 10.1086/674664

Milgram, P., Takemura, H., Ustimi, A., & Kishino, F. (1994). Augmented reality: A class of display on the reality-virtuality continuum. *Telemanipulator and Telepresence Technologies, 2351*, 282–292.

North, M. M. (2014). Distance learning immersive environments: Sense of presence exploration. *Journal of Visual Languages & Computing*, October. doi: 10.1016/j.jvlc.2014.09.006

Ramsay, J. O. (2000). *TestGraf: A program for the graphical analysis of multiple choice test and questionnaire data* [Computer Program / Windows Version]. Montreal, Canada, McGill University.

Roy, A. (2005). Debating the issues: A tool for augmenting critical thinking skills of marketing students. *Journal of Marketing Education, 27*(3), 264-276. doi: 10.1177/0273475305280533

Santor, D. A., & Ramsay, J. O. (1998). Progress in the technology of measurement: Applications of item response models. *Psychological Assessment, 10*(4).

Sautter, P. (2007). Designing discussion activities to achieve desired learning outcomes: Choices using mode of delivery and structure. *Journal of Marketing Education*, *29*(2), 122-131. doi: 10.1177/0273475307302014

Stefan, L. (2012). Immersive collaborative environments for teaching and learning traditional design. *Procedia - Social and Behavioral Sciences, 51,* 1056–1060. doi: 10.1016/j.sbspro.2012.08.287

Saadé, R., & Bahli, B. (2005). The impact of cognitive absorption on perceived usefulness and perceived ease of use in on-line learning: An extension of the technology acceptance model. *Information & Management, 42*(2), 317-327.

Saade, R., Nebebe, F., & Mak, T. (2011). Knowledge management systems development: Theory and practice. *Interdisciplinary Journal of Information, Knowledge, and Management, 6*, 35-72. Retrieved from https://www.informingscience.org/Publications/1361

Saadé, R. Tan, W., & Kira, D. (2008). Is usage predictable using belief-attitude-intention paradigm? *Issues in Informing Science and Information Technology, 5*, 591-599. Retrieved from https://www.informingscience.org/Publications/1030

Sumners, C., Reiff, P., &Weber, W. (2008). Learning in an Immersive Digital Theater. *Advances in Space Research, 42*(11), 1848–1854. doi: 10.1016/j.asr.2008.06.018

Young, M. R. (2005). The motivational effects of the classroom environment in facilitating self-regulated learning. *Journal of Marketing Education*, *27*(1), 25-40. doi: 10.1177/0273475304273346

Van Schaik, P., Martin, S., & Vallance, M. (2012). Measuring flow experience in an immersive virtual environment for collaborative learning. *Journal of Computer Assisted Learning, 28(*4), 350-365.

APPENDIX

Table A.1. Test questions and associated rankings of quality, difficulty and total number of students that ranked each question (TR).

Question	TR
What variable turned out to be less significant than previous research had shown?	4
The aim of the Connor et al.'s (2014) paper is to test the relationship between (select the correct two)	4
What is the strongest moderator in student academic performance?	5
Which of the following are correct statements about Western and Eastern education?	4
Which of followings is NOT the main objective in this study?	4
According to Connor et al (2014), what source influence children's' learning?	4
Which three are the dimensions of ISI system?	4
According to the authors, which of these variables has received less attention in research and needs further investigation?	4
What are the 3 main domains on which students are tested?	4
What is one of the strongest moderators in students' academic performance?	4
Which of the following is not one of the 10 constructs examined?	4
Which of following variables is not the suggested to investigate in future large-scale international assessment?	4
The study concludes that learning motivation is	4
What coding system is used by Connor et al. (2014)?	4
Which two are parts of code-focused instruction?	4
Students showed the greatest gains in vocabulary and comprehension when	4
True or false: Connor et al.'s (2014) study furthers our understanding of which dimensions of the CLE provides better predictors of learning at the individual student level.	4
According to Li (2012), what are the emphases of Western educational system, on which Eastern educational systems have less emphasis?	4
What are some of the pitfalls of the present study that future studies should address?	4
What is the aim of investigation of this paper (Connor et al (2014)) ?	5
Which of the following is incorrect about Cohen's d?	4
Connor et al(2014) cite which paper to show that measurable variability in the effectiveness of teaching has direct implications for students′ success or failure	4
Why is it possible for a student with high quality teacher not to earn desired outcome in language arts?	4
What are the sources of influence on learning in the dynamic systems framework used by Connor et al. (2014)	4
What is the central thesis proposed in Connor et al.'s (2014) article?	4
What are the big concerns of the authors regarding the education system in Asia?	4
What dimensions were the ISI/Pathway rating scale designed to rate?	5
Which of following is NOT a cautionary remarks for the paper suggested by the author?	4
Which of CLE quality or amount/content/type of instruction students received independently predicted student's vocabulary & comprehension gains?	4
What are the workshops the professors receive for their professional training (Connor et al 2014)?	4

BIOGRAPHIES

Samie Li Shang Ly is a Ph.D student in Business Technology Management at Concordia University, John Molson School of Business. She completed a Master Degree in Marketing from the same University. Samie previously has experience in Marketing Research and Business Intelligence. Her career goals are to continuously use the latest technologies to understand the business world.

Dr. Raafat George Saadé has been teaching in JMSB since 1998. He obtained his PhD in 1995 (Concordia University) after which he received the Canadian National Research Council (NSERC) postdoctoral fellowship, which he completed at McGill University in Montreal. Dr. Saadé has extensive industry experience: research project manager, product developer and supply chain manager, operations manager, project leader, and information systems designer. Since 2000, he was also a consultant to the Canadian International Development Agency (CIDA) providing advice on international projects in Ukraine, Pakistan, and Slovenia. In the past 3 years, Dr. Saadé has been a senior advisor at the International Civil Aviation Organization (ICAO) providing input on strategic planning for organizational change. Dr. Saadé has published in top tier journals such as Information & Management, Decision Sciences, Education and Computers, Decision Support Systems, Computers and Behavior, Journal of Information Technology in Education, and Expert Systems with Applications.

Dr. Danielle Morin is a Professor at the John Molson School of Business at Concordia University, Montreal, Canada. She received a BSc in Mathematics and MSc Statistics from Université de Montréal, and a PhD in Statistics from McGill University. Her major academic interests are business statistics and multivariate statistics, which she has taught in both graduate and undergraduate programs. Her current research interests are focused on university education, namely the impact on technology integration and interdisciplinary on student's learning and acquisition of higher order skills. Over the years, Dr Morin has held several senior administrative positions at Concordia University. In 2005, she was awarded the YWCA Women of Excellence Award in the Education Category as well as the Concordia Alumni Recognition Award for teaching excellence.