Toward a Teaching Strategy Design for Game-Based Learning

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Abstract: In this paper, we apply interactive teaching strategy and game-based theories to improve the lecture of Programming Fundamentals such that students have more willing to concentrate on their learning in this lecture. We increase more portion of game-based programming in this new proposed lecture in contrast to the previous lecture only teaching the traditional content. In addition, the game-based theory combines with social presence theory which can give more interactive between the teacher and students. Therefore, it can improve learners' interest and efficiency in learning. Moreover, we design an experimental and a control classes from the Programming Fundamentals course, each class having 40 students. This forms a comparison on the implementation of curriculum design Games-Based Learning theory for experimental group and general education theory in classroom for control group. The pre-test score suggested no significant differences between these two groups of students, while the post-test score clearly indicated a big advantage of the experimental group class over the control group class.

Keywords: Collaboration Learning, Cooperative Learning, Game-Based Learning, Social Presence

1. Introduction

1.1 Overview

This research tries to use a variety of possible techniques and a game-based theory to achieve the goal of optimal teaching and learning. It allows teachers and students to achieve their presentation and interaction easily to create an atmosphere environment in classroom. We apply above theory as the base of teaching architecture design to construct game-based programs and interesting teaching materials from the teacher, so that learners can easily accept in social presence environment of classroom. In other words, the game-based theory will be a modest increase participation of social presence in the classroom between teachers and students, and improve learners' interest and efficiency during the learning period.

1.2 Motivation

Multimedia teaching materials in the traditional teaching and learning are quite diversified, like the streaming video proposed by MIT OCW (open courseware) which has been widely accepted and used in teaching and online learning. Later in the 1960s, due to advances in computer technology, computer-based instructional materials have been widely used in education and most of the universities as their supplementary learning contents.

In view of the above, how to digitization for teacher to use the programs or teaching architecture design to construct game-based programs and interesting teaching materials in lectures to increase the readers' learning effectiveness is the very important trend and issue.

Due to the attention to rise of classroom developed rapidly, it becomes more and more attractive for a lot of researchers. As we know, we can find a lot of poor teaching materials which need to be

improved. Therefore, in the teaching theory there still needs much more good smart ingenuity and learning environments supporting to prompt the learner, which can more easily absorb and the teachers can breakthrough cognitive loading limit to effectively improve of students learning.

2. Literature Review

2.1 Collaboration Learning

Students are collaborating with each other through a media to learn more about specific subjects, to test out ideas and theories, to learn facts, and to gauge each other's opinions (Otero, Milrad, Rogers, Santos, Verissimo, & Torres, 2011; Jones, & Issroff, 2005; Smith, & MacGregor, 1992). In most cases, the collaboration process boosts everyone's interactive frequency.

According to Jones and Issroff (2005) research on collaborative learning and educational technologies, some key concepts are needed to take into account the interaction between cognitive, social and affective/emotional factors (Otero et. al., 2011; Jones, & Issroff, 2005). Some highlights are summarized as follows:

- Social affinity between partners: some studies suggest that friend relationships facilitate the communication processes and interaction regulation that in turn increase motivation and collaboration.
- Actual and perceived cognitive abilities of the partners: this factor draws the attention to possible difficulties managing asymmetries in collaboration.
- Distribution of control: the way about the different members of a learning group are able to control their learning pace and how available tools enable this process during collaboration.
- Nature of the task: the nature of the task also influences the way a group 'decides' to collaborate. The difficulties of being able to collaborate synchronously might lead to losses in the activities, which increase the chance of demotivation towards group work.
- Time: socio-affective relationships evolve in time. Thus, it is important to conduct longitudinal studies in order to reveal how the different elements of a group are able to appropriate the technologies at their disposal.

2.2 Cooperative Learning

Many studies have been proven that cooperative learning benefits to students with improving their achievement and learning experience. Also, based on mutual cooperation among students, it can enhance students' learning motivation. The five elements of cooperative learning are summarized as follows: (Johnson, 1991; Felder, Richard, & Rebecca Brent., 1994).

- Positive Interdependence: Interdependence is the first element of cooperative learning. Team members can promote positive interdependence via goal setting, resources sharing, and role assignment.
- Individual Accountability: Individual accountability is the second element of cooperative learning. In cooperative learning, the group's success is on behalf of each member's success. In the cooperative learning, each member needs to take the responsibility of his/her success to fit the group success. Definitely, this element can reveal the group spirit in contrast to hero-style performance.
- Face-to-Face Promotive Interactions: A face-to-face promotive interaction is the third element of cooperative learning. Through the guidance of teachers and the arrangements such as experimental groups, group discussions, and group reporting, team members can help each other to exchange information, encourage feedback and progress interaction. Finally, a whole team can be successful in learning and promote to achieve personal goals and group goals.
- Social Skill: Social Skill is the fourth element of cooperative learning. During the cooperative activity, each member in a learning group can develop some social skills including effective communication skills, mutual respect and trust.

- Group Processing: Group Processing is the fifth element of cooperative learning. During the group processing, students can understand and learn some processing manners with their peer.

Therefore, the cooperative learning can enhance the team's solidarity and cohesion. Also, it can increase interaction and enhance each other's feelings to share psychological experience.

2.3 Game-based Learning

Games can provide a learning difference from traditional learning environment and interface. In 2003 Professor James Paul Gee (University of Wisconsin-Madison) made impact on the cognitive development of the game-based learning. They are related research and development in continued. In fact, the popularity of a variety digital tools games is more diverse progress. James Gee believe that the basic value of the game including the provision of the player one kind of sense of control (Ownership), to stimulate lateral thinking, problem solving and teamwork (Gee, 2003; 2014). The player will attempt to overcome the frustration, and adhere to the target. His research indicates that: the game can interact with the participation of the ways to help people learn.

The "Quest to learn" is a middle school with the curriculum based on video games, the designer Katie Salen who specializing in Game-based Learning and spent a lot of time thinking about making learning more relevant to students.

Katie Salen said: Now we have a lot of learning games. However, not all games have good design, the educators often find the learning content and the integration of the game quite challenging. However, what is a good way to learn the game? That can cause learners motivation to play, but also to effectively achieve the purpose of study. The survey found that online gamers spend an average of ten to fifteen hours a week on the Internet to do research on how to crack the game, educational game if you can achieve the same result, it would be great (Salen, 2008).

Also, games include many characteristics of problem solving, i.e. an unknown outcome, multiple paths to a goal, construction of a problem context, collaboration in the case of multiple players etc., and they add the elements of competition and chance. However, online games provide the additional possibility of building teams of players who are geographically scattered. The benefits of learning through games are numerous (Mann et al., 2002), and games are often closer to simulating real life experiences than more traditional educational media. This allows the students to immerse themselves in a realistic simulated setting without the fear of real life consequences, which – although not the necessity it is in Medicine – is also very useful in Civil Engineering (Ebner, & Holzinger, 2007).

The concept of gaming goes beyond games, in the same way in the learning goes beyond the configuration of a classroom management. Gaming constitutes of activities, literacies, knowledge, and practices are instant achievements of teaching management of a game-based learning. Thus, the teachers can set special of behavior and activities in classroom management, which focused on determining, within specific behavior settings, environmental conditions that influenced behavior (Emmer,1987; Emmer & Stough, 2001). Therefore, the main purpose of classroom management is to make students enjoys in social learning environment and to participate in teaching activities in the classroom.

Gaming plays across media, time, social spaces, and networks of meaning. It includes engagement with digital FAQs, paper game guides, parents and siblings, the history of games, as well as the games themselves (Salen, 2008). Therefore, the requires players to be fluent in a series of connected literacies that are multimodal, performative, productive, and participatory in nature social presence. In other words, they are same as the social interaction between students and teacher in classroom. The main purpose is to enhance learners' learning attitude, interest and efficiency in the learning process.

2.4 A Game-Based Learning Design Be Leveraged to Enhance Cognitive Adaptability

McFarlane (2002) argues that the gaming generation is bottom-line oriented. He states that students often want metrics and want their performance measured if the form of measurement is meaningful to them. As the players improve, the gamers expect the challenges to become more demanding. Translating this into classroom pedagogy is critical for reaching students who learn well in this type of environment.

Galarneau & Zibit, (2011) mentioned that the 20th century visionaries foresaw that mastery of the dynamic processes underpinning the acquisition and manipulation of knowledge would be critical in the 21st century. Formal educational systems have not yet changed to facilitate the development of these necessary capabilities, and so people of all ages are developing them through a variety of digitally mediated mechanisms. Online games offer one area in which to examine patterns of spontaneously occurring phenomena that represent the natural development of such capabilities.

3. Method

To test the assumed effects of the navigational feedback concerning a true experiment (Ross & Morrison, 1996) was carried out in which participants were assigned to an experimental group and control group. In other words, we offered to use game-based learning to the experimental group and in a control group we proceeded through an otherwise identical learning without any policy to strengthen the teaching and learning strategy game-based learning on the classroom.

3.1 Participants

Participating students are in the MingDao University of Taiwan. There are regular college students who take an elective Programming Fundamentals course in February 2016, which is a basic programming language. The total number of students is 80. We randomized grouped into the experimental and control groups. Our subjects were 40 students to do three weeks of use Games-Based Learning theory for experiment. The other 40 students to do a three-week general education in classroom. But in the Quiz, the two of group each have one student absent in week 4.

The announcement highlighted that the course was designed with the purpose of understanding data structure of programs, that it would take approximately 9 hours to study the course (3 hours each week). The course would be available to begin the first phase of a 3-weekscourse in February 2016. In the course, a student must complete the test pass to receive a final grade of 25% score. A prerequisite knowledge was defined as: "having some experience with Internet (surfing the web and using email) and a passive understanding of English". At the start of the course, participants were asked to fill in a small questionnaire aimed to gather some basic background information about the learners: age, sex, educational level and computer skills.

In this study, we did literature review, and made questionnaire pre-test for the experiment to collect and analyze the student data before the experiment. Two classes whose level are almost the same were looked as experiment class and control class separately by an exam. After a pre-questionnaire statistical results of the experimental group, the male and female students were 18 and 22. A control group of male and female students were 16 and 24, as in this experiment. The pre-test score suggested no significant differences between the two groups of students.

3.2 Mode Design

The experimental group and the control components of two classes, each 40 students in classroom. The Fig. 1 is the comparison on the implementation of curriculum design Games-Based Learning theory and General education in classroom.
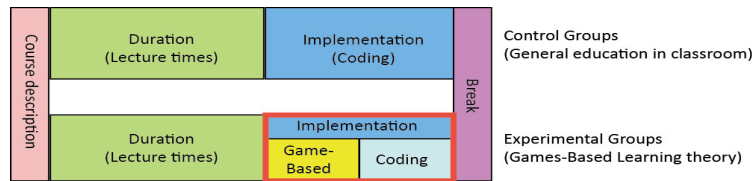
Fig. 1. Comparison on the implementation of curriculum design Questionnaire design

This study uses questionnaires measured the five-point Likert scale mining scale. Likert scale (Rensis Likert) is a psychological reaction scale, often is used in the questionnaire, and is the most widely used scale. Such questionnaire answered by the project is total 12 items.

3.3 Analyses

The first hypothesis states that the games result in more effective in experimental group for game-based learning environment of classroom. We tested for two different variables: The first consideration is related to the course contents of the game. The second consideration is the content of the game not related to the course topic. The premise is that student must complete a three-week course on this case and is not absent from class.

The second hypothesis states that the student is interested in the course in experimental group how just love the game or like teaching curriculum into the game-based learning environment of classroom. The first job is to design a program called "告白 (serious relationship)" game to let students more encouraging retype the "I love you" from the program C to replace "hollo", and then disclosed to the projector. The second job is to design the data structure "if... else..." game from the program C. A team of students should use "if ..., else ..." to clarify some relationship and cooperative thanking. They make a program in collaboration to show their idea in the C program. For example, someone designs a program "I love you, do you love me too?". The program has been designed to wait for answer in choosing, the follow-up program will analyze formula "if…, else…" function in C program. The Fig. 2. is the students observed a C programs coding for cooperative learning.

Fig. 2. The students observe a C programs coding for cooperative learning.

4. Results

4.1 Effectiveness

The results for effectiveness has been described separately for the two variables amount of progress made towards achieving the goal (the number of student questionnaire responses and feedback) and goal attainment (the number of learners completing three-weeks class). Moreover, the teachers' course design description has been arranged before the class in the experimental and control group classroom.

According to the five-point Likert scale questionnaire, we ask students the following question: "If the teacher uses Game-Based mode teaching in class, it may increase my interesting on classroom?". The result obtained to select 4 or more accounted for 61.6%. The Fig. 2. showing the students are interesting to the Game-Based learning in classroom. The Fig. 3. shows the students' acceptance rate in Game-Based learning method.

Furthermore, the above activities have no significant differences between the two groups of students on the pre-test score in t-test. After three weeks of teach in classroom, we make a quiz in the classroom. The post-test is clearly indicated a big advantage of the experimental class over the control class (Fig. 4, Fig. 5).
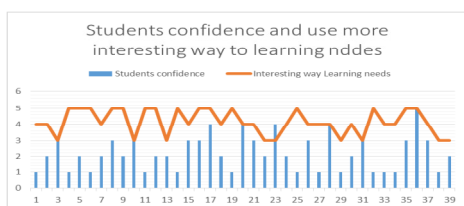
Fig. 2. Before the class, the students consent using interesting way to learning and confidence rate.
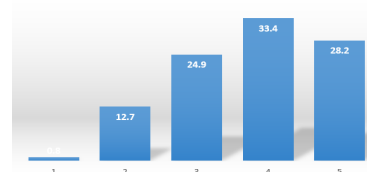

Fig. 3. The students had acceptance rate of Game-Based learning method.
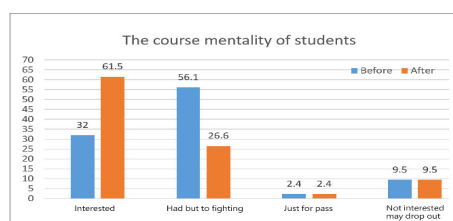

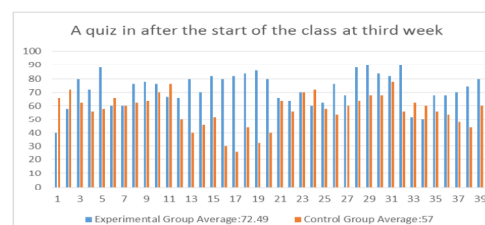Fig. 4. The course mentality of students in before and after.

Fig. 5. A quiz in after the start of the class at the third week.

5. Conclusions

The results of the experiment lead us to conclude that Games-Based Learning theory which can support our design, which including integration into the cooperative and collaborative learning theory to enhance the learners' learning effectiveness. Thus, it showed a significantly higher amount of progress and higher learning rates in the experimental group. The Games-Based Learning theory proposed in this study did have a significantly positive effect on efficiency.

There are, however, a number of limitations with the experiment. First, although we get some evidence to suggest that the proposed method is effective, there is no evidence that can be applied to all courses. Second limitation lies in our use of elapsed time rather than actual study time. In addition to student learning and discipline in the classroom, also some extracurricular possibilities made unpredictable efforts which we do not have this measurement. Third, we do not have classroom design for dedicated gaming App to improve the social presence in the classroom between teachers and students.

A further clarification of the results could be extending to include a greater proportion of a learner first class test, midterm and final test of corroboration might lead to stronger effects. Further research is needed to address the above Games-Based teaching method to this research topic to have a greater impact on effectiveness and efficiency in class learners.

Despite the limitations of the present study, we believe it shows that the use of Games-Based teaching and learning method principles is efficient and effective in class learning.

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