How are Serious Games used in the Classroom setting? - Based on the Learning Theory

Chung-Il Hwang¹ and Sahoon H. Kim²*

¹Korean National Institute for General Education, Korean Council for University Education, South Korea; edusunny@daum.net
²College of Education, Hankuk University of Foreign Studies, South Korea; kimsh@hufs.ac.kr

Abstract

Background/Objectives: The purpose of this study is to identify how serious games can be utilized for an educational purpose. Educational psychologists categorize learning theories into three subjects; behaviorism, cognitivism and constructivism. Methods/Statistical Analysis: This study was designed based on the methodology of Design-Based Research (DBR) and for analysis of research, coding technique of grounded theory was borrowed. To analyze the practical educational use of serious game, the researcher designed and applied high school English class that utilizes a serious game. Findings: In the aspect of behaviorism, advantages of serious game were discovered by seeing the fact that students were exposed to the environment where they could easily memorize through getting achievements and retaining memory with repetition. Such compensation was easily implemented due to a strengthening element that serious game itself has and students could be easily immersed through it. In the aspect of cognitivism, the possibility of a cross subject learning through designing game environment by teachers was discovered and the ease of learning could be utilized through task-based learning. Also, teachers can make use of this method to connect students' prior knowledge and new information by presenting appropriate amount of work. On the other hand, in the aspect of constructivism, researchers developed a process of meeting students while maintaining anonymity to effectively observe student problem-solving in the game. Multi-dimensional interaction and resolving issues generated by difference of cultural literacy other than difference of language present not only an environment to students but also new task to teachers. Application/Improvements: The results are significant in the study of serious games that it presented the connection between a function of game and a learning type.

Keywords: Educational Psychology, EFL, Game Learning, Learning Theory, Serious Game

1. Introduction

Along with technical developments, a variety of learning methods through serious games are being attempted. Serious games are already recognized as more than a replacement for supplementary education. The educational possibility of serious games have been carried out by various fusion researches including pedagogy, psychology, business administration, etc¹. Expectations for the serious game is a trend of further growth, along with financial support from gaming industries and governments all over the world². Historically, serious games were used as tools to improve students’ memory and have evolved into a variety of forms such as simulation, 3D and recent mobile environment. However, it is not easy to find other studies that support the notion that serious games generate educational progress. Although educational psychology describes what generates systematic and academic learning, it is hard to find studies that describe the educational environment of serious game based on the learning theory and the best practice about the following effect and teaching method of it. This study designs and implements English as a Foreign Learning class utilizing one of the serious games named Quest Atlantis (QA) to
classify and present empirical experiences in classes into the frame of learning theory.

2. Related Works

2.1 Previous Studies

Reasons for the educational use of serious gaming are found in studies about the positive learning effect such as increased student engagement, learner-centered class environment and problem-based learning method. Research on serious game, excluding British-American countries, is actively being conducted especially about usefulness of foreign language learning environment. This phenomenon can be explained with language learning from the immersion of serious game users, reduction of shyness from anonymity, opportunities to communicate with foreigners and cultural diversity through social networks. Moreover, research on serious game as a functional use for online cooperative learning is being conducted in many ways. The research on serious game for overcoming problems of online cooperative learning that utilizes messenger include such as absence of visual hint, difficulties of immediate response. It is important to understand the effect of serious games in detail and how it can be explained on the basis of any psychological paradigm. This is because learning theory can give guidance to teachers who utilize serious games and also propose scientific and detailed knowledge for the improvement of teaching and learning process that can occur in the classroom.

2.2 Psychological Categorization of Learning Theory

The knowledge which provides the basis for instructional design theory is a learning theory on how learning occurs through any psychological mechanisms. Learning theory can be divided into three large paradigms which are behaviorism, cognitivism and constructivism.

The behavioristic approach highlights ‘stimulation’ and ‘reinforcement’ as the external environment that causes a learned behavior. Operational conditions and related theories have affected the formation of behavioristic learning theory. According to the theory, positive reinforcement given towards a desirable reaction promotes learning, while negative reinforcement given towards an undesirable reaction reduces the frequency of undesirable behavior and leads learners to desirable ways. Behaviorism has influenced learning theory a lot, however, it has a limitation in that it recognizes learners as passive beings and focuses only on external behavior than internal mental process. In other words, this behavioristic approach has a limitation in that it does not sufficiently explain human's intellectual capacity to solve complex problems because it does not consider human's thinking process that can happen until a certain behavior is expressed.

Cognitive approach recognizes learning as to know, understand and cognize something on the inner side. 'Information processing theory' is one of cognitive approaches that influenced instructional design. This theory explains the process of saving new information and proposed a hypothetical construct that divides memory into three areas: 1. Sensory storage, 2. Short-term memory, 3. Long-term memory. There came a basic teaching strategy called 'chunking' that limits the amount of explanation at a time considering the capacity of short-term memory and a concentration principle for effective classes, a encoding principle and elaboration principle were presented considering long-term memory's preliminary knowledge activation. However, this approach has a similar limitation with behavioristic approach that it is fragmentary and it recognizes learning as a process happening inside the learner and excludes interact of learning environment surrounding learners.

According to constructivist, knowledge doesn't exist outside but it gains its meaning by people and learning is a process that learner actively composes its meaning. Therefore, learning based on constructivism focuses on designing environment to help learner actively explore complex topic and environment and to think as an expert in a given area. To do this, for the implication for teaching instructional design, designing a learner-centered environment, problem-solving-centered learning, teacher as facilitator, cooperative learning, concerning actual assignment and context and process-centered evaluation are proposed.

People and social cultural interact around learners through Zone of Proximal Development. Zone of Proximal Development means an area which the child can reach to solve problems that they cannot solve by themselves but they can when they learn with adults or peers ahead of them. This step is where the teaching is required so adults or peers learning with the child provides learners with scaffolding to make them intellectually
grow through solving problems. Along with the development of IT and the use of cutting edge technology, that it became possible between learners and between learners and instructors to interact regardless of space time and a highly difficult thinking skill such as problem-solving ability, actual assignment, critical thinking skill and logic inferential skills are emphasized\(^4\). However, constructivism has limits, which are absence of objectives, overlooking students’ advance learning level, evaluation criteria and insufficiency of controlling beginner learners. Hence, exteriorization is required to design the practical classes. Table 1 presents schematic description about it.

### 3. Proposed Method

This study was designed based on the methodology of Design-Based Research (DBR)\(^5\) and for analysis of research, coding technique of grounded theory was borrowed\(^6\). To analyze the practical educational use of serious game, the researcher designed and applied high school English class that utilizes a serious game ‘Quest Atalantis’ and it was focused onto educational method to be analyzed. The class designer finished training of class designing that utilizes Quest Atlantis for English education by cooperating with production team of Quest Atlantis of Indiana University in 2008 and conducted ‘designing elementary school English class utilizing serious game’ in 2009 and ‘English immersion class utilizing Avatar’ for middle school students in 2010. The key considerations of serious game utilizing classes include learners’ English level, computer utilization ability, decrease of students’ engagement.

Considering learner’s English level and computer utilization ability, ten second grade students in high school who participate in afterschool class were chosen as research subjects. Since the participant students are from male-only high schools, all participants were male students and they were recommended as participants by their English teachers. Most participants had no problem in expressing what they like to say in English and they are also good enough at computer to handle emails and YouTube and QA. The class was conducted 15 times for 4 months and there were three mission accomplishing classes designed by instructors and English teachers, mission in Quest Atlantis and free discussion sessions for the class. Table 2 presents research subjects.

### 4. Results

#### 4.1 Learning Method in the Aspect of Behaviorism

A role of teachers who joined the aspect of behaviorism is to form students’ behavior. To do this, teachers should provide proper stimulation and reaction and strengthen students’ behavior. It has a clear goal in terms of aiming predictable change in behavior. In QA, learning in the aspect of behaviorism made its clear appearance in video scripted learning that was imprinted in serious games.

| Table 1. Comparison of learning theory |
|----------------------------------------|
| **Behaviorist** | **Cognitivist** | **Constructivist** |
| Philosophical Background | Objectivism | Objectivism | Constructivism |
| Scholar | Skinner | Bruner | Piaget, Vygotsky |
| Teaching Paradigm | Teaching / Instruction | Teaching / Instruction | Learning |
| Teacher’s Role | Shaping learners’ behavior | Linking new information with schema | Facilitator |
| Learning Process | Stimulus and Response, Enforcement | Organizing, Remembering, Recalling Information | Constructing new meaning based on learners’ experience |
| Instructional Design | Behavior Object/ Criterion-reference evaluation/ Feedback | Organization, Sequence of information / Transfer of information / Analysis of schema | Analysis of context / Providing different situation / Problem based learning / Social learning / Collaborative learning |
Table 2. Research subject

| Case    | High School |
|---------|-------------|
| Grade   | 2nd         |
| Class size | 10 students |  |
| Time    | 15 hours 15 weeks, 1 hour a week |

To proceed the serious game, student participants had to understand the English video in QA. They showed more attention in that video than when they watch normal English videos. Since the videos were played on personal computers, student participants repeated watching the videos by their own and when there were new words they learned it by utilizing computers. Many questions came out in classes and teachers could react to the questions while keeping the flow of the lesson (See Figure 1).

Teachers should explain difficult words and make students practice it repeatedly to acquire it. Also, giving quizzes about key phrases and giving compensation to students from it could be a good teaching method. This is very similar to the traditional teaching method called ‘drill and practice’. However, the fact that videos are played in serious games itself already brought different motivations from just watching videos. It is because the story line is related to the content of serious games that student participants will play.

It could be explained with the limit of behaviorism. In the aspect of behaviorism, learning only focuses on external behavior of human rather than focusing on mental operation. This aspect could be advantageous when aiming simple memorization and detailed goals as the objects, however, it does not guarantee that it could affect highly difficult thinking. In addition, since student participants’ immersion was brought by playing games, the research found that their interest cannot last. These are what are necessary to do when conducting instructional design for learning in the aspect of behaviorism. First, specific goals for learning and the least amount of study for students should be set. Second, teachers need to guide students to utilize the new knowledge they acquired in the aspect of behaviorism so that it could be the base for the other activities. Third, teachers should prepare a variety of activities for conveying the interest of learning to students who are genuinely interested in playing games.

4.2 Learning Method in the Aspect of Cognitivism

In the aspect of cognitivism, it is important to help students to connect schema they acquired through advance learning and new information. To do that, when designing classes that utilize serious games, teachers should consider how to connect existing content of class and new educational objectives. In this study, there are two patterns of learning methods that utilize serious games in the aspect of cognitivism. First, there is task-based learning in a new environment that uses knowledge learned from other subjects and familiar phrases when learning English expressions.

Visual elements of serious games can be utilized when learning how to express the knowledge acquired from other subjects in English. For instance, you can use a teaching method design from serious games to instruct English expressions for knowledge learned in art class. This research utilized the way of making students explain Van Gogh’s pictures in the QA screen in English. Students used their schema to solve the new learning task which was to expressing the picture in English. Since serious games provide rich visual information, it is in a good condition to give good education opportunities of this type.

To effectively realize this method, teachers should have deep understanding of students’ advance learning and class designing ability customized for proper student level and understanding of serious games’ interface.

Second, serious games could easily perform task-based language learning. Serious games provided active educational situation that led students’ participation rather than being an assistant way of face-to-face classes. Task-based language learning is a way of teaching method that sets up a specific situation in class, for example, students should give a direction to foreigners on the street so that they can naturally have communication in English\cite{17}. However, this teaching method has a limit to apply in real life. First, it is not easy for students to immerse in that situation. Second, when the situated task is resolved there is no visual reaction to and it gets difficult to have
continuous conversation. Third, it is difficult to control when students talk to each other in their native language (Korean). Task-based language learning that utilizes serious games provide visual environment and it is easy to design reactions to it and it gets easy to promote students’ cognitive development. Also, it is effective to solve technical problems as controlling language.

4.3 Learning in the Aspect of Constructivism

In the aspect of constructivism, teachers are environment facilitator. To connect students’ experience to educational meaning and newly organizing from it becomes a learning process. To do this, serious games should provide new environment to students so that they can have meaningful experience that they can make themselves. In this respect, serious games have the biggest advantage.

In QA, students easily met native English speakers and had no difficulty in communicating with them in English. Moreover, they tried to get help from the native English speakers to do their homework. An interesting fact was found in this process, which was that the amount of communication with users from another countries students had was far smaller than the amount of communication with users from the same country even when speaking in English in both situations.

In many cases it was because it is hard to find new expressions generated from cultural differences. For example, unconditional meeting with foreigners in serious games have problems that it is hard to bring common issues other than presented linguistic conditions unlike ESL (English as a Second Language) environment in real life. To solve this problem, it is necessary to resolve the difficulties of contents design that can lead mutual cooperation with foreigners.

Especially, learners can resolve problems by themselves through children’s Zone of Proximal Development. This means cognitive development in QA is possible when continuous conditions between native English speakers and non-native English speakers are provided. In other words, in addition to providing spaces for students to communicate with foreign users through the game, presenting conditions to naturally help students communicate with them is also necessary.

Learning outcomes of constructivism has advantages that transition is easy since English was naturally learned in contexts and also it can be used in real life. In addition, students’ immersion lasted not because of the interesting element of the game but because of the interest derived from the interaction with other users. The game played a role of providing the environment for that. That is, when designing teaching method that utilizes games, to induce learning in the aspect of constructivism leading interaction with others in an open space is more desirable than putting the emphasis on the function of games. Yet, scaffolding for interaction with others should be made rather than placing the learners in the space themselves.

5. Conclusions

It is an empirical study for the investigation of the teaching method utilizing serious games that the researcher used design-based research method and modified and implemented the game to observe learners. To theoretically classify learners’ learning, this study utilized learning theory of educational psychology as a theoretical framework. The result of this study showed that serious games induced learners to a variety of learning methods. In the aspect of behaviorism, it is appropriate to have interesting learning process to help learners learn basic contents. In the aspect of cognitivism, integration learning among different subjects and task-based learning for students are appropriate. In the aspect of constructivism, classes utilizing serious games have an effect of leading students to interact with various users in an open space. In this case, however, teachers need to continuously present conditions for interaction with other users to help student through scaffolding. The results are significant in the study of serious games that it presented empirical results about how education that uses games can be conducted in the future by explaining the connection between a function of game and a learning type.

6. Acknowledgment

This work was supported by the Hankuk University of Foreign Studies Research Fund of 2015.

7. References

1. Wouters P, Spek VED, Oostendorp VH, Connolly T, Stansfield M, Boyle L. Current practices in serious game research: A review from a learning outcomes perspective. Games-based Learning Advancements for Multi-Sensory
How are Serious Games used in the Classroom setting? - Based on the Learning Theory

1. Human Computer Interfaces: Techniques and Effective Practices. Information ScienceReference; 2009. p. 232–50.
2. Kim J, Jung J, Kim S. The relationship of game elements, fun and flow. Indian Journal of Science and Technology. 2015 Apr; 8(8):405–11.
3. Ge ZG. Exploring e-learners' perceptions of net-based peer-reviewed English writing. Computer Supported Learning. 2011; 6(1):75–91.
4. Zheng D, Young MF, Wagner MM, Brewer RA. Negotiation for action: English Language Learning in game-based virtual worlds. The Modern Language Journal. 2009; 93(4):489–511.
5. Kim SH, Lee JL, Thomas MK. Between purpose and method: A review of educational research on 3D virtual worlds. Journal of Virtual Worlds Research. 2012; 5(1):1–18.
6. Hong SR, Shin IY. The application of multimedia and wireless technology in education. Indian Journal of Science and Technology. 2015 Aug; 8(20):1–11.
7. Paas F, Renkl A, Sweller J. Cognitive load theory and instructional design: Recent developments. Educational psychologist. 2003; 38(1):1–4.
8. Ertmer PA, Newby TJ. Behaviorism, cognitivism, constructivism: Comparing critical features from an instructional design perspective. Performance Improvement Quarterly. 1993; 6(4):50–72.
9. Skinner BF. Operant behavior. American Psychologist. 1963; 18(8):503.
10. Sweller J. Cognitive load theory, learning difficulty and instructional design. Learning and Instruction. 1994; 4(4):295–312.
11. Phillips W. On the distinction between sensory storage and short-term visual memory. Perception and Psychophysics. 1974; 16(2):283–90.
12. Jonassen DH, Howland J, Moore J, Marra RM. Learning to solve problems with technology: A constructivist perspective. 2nd ed. Ohio: Merrill Prentice Hall; 2002. p. 256.
13. Vygotsky LS. Mind in society: The development of higher mental process. Massachusetts: Harvard University Press; 1978. p. 159.
14. Savery JR, Duffy TM. Problem based learning: An instructional model and its constructivist framework. Educational Technology. 1995; 35(5):31–8.
15. Bell P. Collective TD-BR. Design-based research: An emerging paradigm for educational inquiry. Educational Researcher. 2003; 32(1):5–8.
16. Corbin J, Strauss A. Basics of qualitative research: Techniques and procedures for developing grounded theory. California: Sage publications; 2014. p. 312.
17. Pica T. Research on negotiation: What does it reveal about second-language learning conditions, processes and outcomes? Language Learning. 1994; 44(3):493–527.