Shih, J. L. et al. (Eds.) (2019). Proceedings of the 27th International Conference on Computers in Education. Taiwan: Asia-Pacific Society for Computers in Education

Enhancing Computer Assembly Skill Using Virtual Computer Laboratory in Conjunction with Team Game Tournament Method

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Abstract: The aim of this research was to develop the computer assembly skill using virtual computer laboratory in conjunction with team game tournament (TGT) method. We exploited virtual reality technology in developing virtual computer laboratory which was designed and developed as an interactive media in form of 3D animation model displayed in 360 degree perspective with sound effect so that learners are able to get experience like being in a real environment. TGT was used in our learning management process which motivated learners to encourage, help each other to solve problem, enjoy to learn and challenge from the activities in class. Research instruments consisted of VR-based virtual computer laboratory, pretest-posttest, questionnaires and lesson plan. By purposive sampling, the participants in our preliminary study were 12 high school students who had low pretest score. The data were analyzed by mean, standard deviation, and t-test dependent. The results showed that the average posttest achievement score was statistically higher than that of pretest at significant level of .05. The average normalized gain of class was 35.83 percent which was at the medium level. In addition, the average of overall students' satisfaction was 4.29 (SD=0.60) which was at the high level.

Keywords: Virtual Laboratory, Virtual Reality, Computer Assembly, Team Game Tournament

1. Introduction

Computer assembly is a large part of a computer skills needed a logical, methodical manner when working with computer components, thus it is necessary to improve computer assembly skills dramatically with practice (Cisco, 2006).

Computer subject has been added, by the basic education core curriculum of Thailand, to be a parts of science area curriculum since 2017. The purpose of this subject is to develop students' knowledge and understanding about technology for everyday living (Ministry of Education, 2017). As, to know technology is not only knowing the way to use it, even so, to know the way to maintenance it is also important. In Thailand, some secondary schools who foresee this advantage also provided computer maintaining session for students along with general computer class.

In fact, the high school in Ubon Ratchathani, Thailand has placed computer maintenance subject in 12th grade curriculum in order to prepare first step of computer assembly knowledge and to arrange fundamental skill in computer maintaining for their students (Course description, 2018). With this kind of learning, the school certainly needs workshop class that allows student working on real computer devices. From on-site class experiences, regarding fresh trainees and pieces of computer component are highly electrical sensitive, the practical of students work on real equipment caused damages in almost all experimental accessories. Since the price of computer devices are expensive and the limited of school budget, a teacher needs to use the crashed components for students practicing and it led to the cause of students unable to learn computer assembly as good as it need.

From the problems mentioned above, the cutting-edge technology can help to simulate real event and offer ability to virtually engage activity. The demonstration method called virtual reality (VR) technology allows user to see and manage 3D images or objects by wearing head-mounted device or sensor glove in virtual environment (Malithong, 2000). Using this technology, the teacher does not

need to teach computer assembly subject by real hardware, on the other hand, they can use VR technology to enhance their classes without limitation of hardware damages.

Moreover, it also needs learning method for helping students to understand content and to engage in study. Since computer equipment is sophisticated electronic component, high school students who have no basis in this knowledge will be difficult to overcome subject matter which lead to boredom and undesirable learning. Team Game Tournament (TGT) is a learning method which provided fun learning activities that can be used for producing positive outcome on social, attitude, and academic performance dimension (DeVries, 1980). It manages students in classroom into small groups. Each group has member from all achievement level. TGT is a part of cooperative learning, which motivate learners to encourage and help each other master collaboration, critical thinking and communication skills required in the 21st century skills (Battelle for Kids, 2019).

Therefore, in this study, we integrated the using of VR technology with the advantage of TGT to enhance computer assembly skills of high school students. The VR-based virtual computer laboratory was developed to allow learners to explore inside components of a computer, and to compose each component to get the complete result of the virtual computer by learning activities with elaborating the collaborative from teamwork learning.

2. Methodology

2.1 Populations and Sample Group

30 students from the high school in Ubon Ratchathani, Thailand, who were studying in science classroom program on the first semester of the academic year 2019 were asked to take the pretest. The 12 students who had low pretest scores were selected to be our sample group.

2.2 Research Instruments

2.2.1 Virtual Computer Laboratory

In order to allow students to learn about functions of computer devices and practice their skills leading to enhancement of their computer assembly skills, we designed and developed the VR-based virtual computer laboratory by using the Oculus Rift and Oculus Touch (www.oculus.com) to display and interact with 3D models in virtual environment. In the virtual laboratory, it's consisted of 3 sections including learning center for learning of the devices (Figure 1 (a)), computer assembly practice (Figure 1 (b)), and exercises (Figure 1 (c)).

(a) (b) (c)

Figure 1. VR-based virtual computer laboratory (a) learning center (b) computer assembly practice (c) exercise

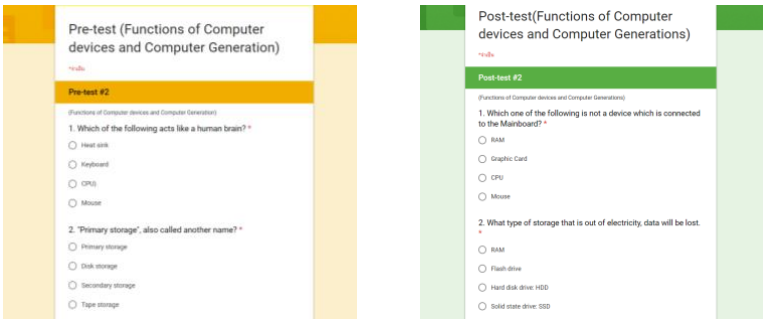
2.2.2 Teaching Plan

Teaching plan was developed based on TGT approach that consisted of 3 steps (Team, Game, and Tournament). In team step, students are divided into groups of 3-4 members. Each group has members from all levels of achievement (high, medium and low-achieving) which is categorized by their pretest score. In the game step, each group will choose the member to assign in tournament table according to member performance. The tournament step allows student do table activities to find the winner in each table and bring their score to be a group score. Our VR-based virtual computer laboratory will be used

during the game and tournament steps. Last step, praise the success, the teacher summarizes each team's score and gives the reward to the winner group.

2.2.3 Pretest-Posttest

Pre- and post- tests were designed based on concept of Bloom (1976) in terms of an objective test and multiple-choice items. There are 20 questions which were divided into 2 different sets (pre- and post-tests). Some examples are shown in Figure 2. They were developed using the Google Forms.



(a) (b)

Figure 2. Examples of tests for evaluating students' understanding of fuctions of computer devices and computer generations (a) pre-test (b) post-test

2.2.4 Questionnaire

There were 11 items in questionnaires used for examine students' attitude toward the VR-based virtual laboratory with TGT. It was developed according to 5-point Likert scale including strongly disagree = 1, disagree = 2, neither agree nor disagree = 3, agree = 4, strongly agree = 5.

2.2.5 Computer Assembly Skill Assessment Forms

There are two skill assessment forms designed according of scoring rubric (Hart, 1994; Pickett & Dodge, 2001) including 5 scales: excellent – 5, good – 4, average – 3, poor – 2, and weak – 1 as illustrated in Figure 3. These forms were used to evaluate students' computer assembly skills.

Criteria	Scale				
	5 (Excellent)	4 (Good)	3 (Average)	2 (Poor)	1 (Weak)
Computer Assembly Level 1	Able to complete the computer assemble and completed on time.	Able to assemble more than 6 computer devices	Able to assemble more than 4 computer devices	Able to assemble more than 2 computer devices	Able to assemble less than 2 computer devices

(a)

Criteria	Scale				
	5 (Excellent)	4 (Good)	3 (Average)	2 (Poor)	1 (Weak)
Computer Assembly Level 2	Able to complete the computer assemble and completed on time.	Able to assemble more than 8 computer devices	Able to assemble more than 6 computer devices	Able to assemble more than 4 computer devices	Able to assemble more than 2 computer devices

(b)

Figure 3. Computer assembly skill assessment form (a) for level 1 (b) for level 2

2.3 Implementation

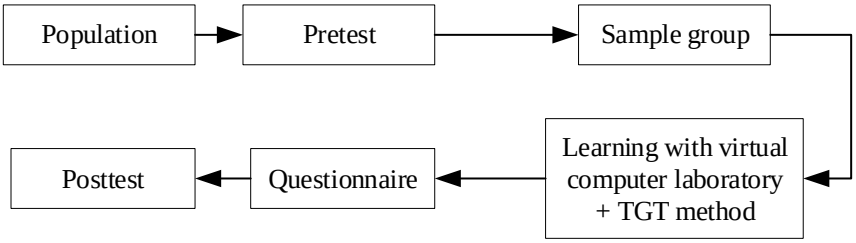


Figure 4. The implementation design and plan

The preliminary study was conducted to investigate the possibilities on the use of the developed virtual computer laboratory integrated with TGT approach in enhancing student understanding on the topic of computer assembly in a high school. Figure 4 illustrates the implementation design started with pre-test and chosen sample group from students, who had score at the last 12th in the score rank. After that, 12 students were categorized into 3 ability groups: high, medium and low achieving. Then the teacher assigned the students into 4 teams called home group; each home group consisted of 3 members with different abilities. In the team step shown in Figure 5 (a), students from home group were shared the duties among their team to study the computer generations and functions of computer devices through the learning center in the VR-based virtual laboratory; each group was given the limited time. In the tournament step shown in Figure 5 (b-c), the student was assigned to assemble the computer in the virtual laboratory in which there were three levels. The low, medium, and high achieving students were assigned the level of 1, 2, and 3, respectively. The score from each student was summed to be a group score. Finally, teacher and students summarize each team's score and students did the post-test. In addition, teacher asked the students to answer the questionnaire in order to investigate students' satisfaction toward virtual computer laboratory.

(a) (b) (c)

Figure 5. The preliminary study (a) learning with the virtual lab, (b) medium-achieving students assemble computers at level 2, (c) high-achieving students assemble computers at level 3

3. Results

3.1 Learning Achievement between Pretest - Posttest and Normalized Gain

Table 1
Learning achievement score

Students	Pre-test (20)	%Pre-test	Post-test (20)	%Post-test	Normalized gain
1	6	30	16	80	0.71
2	8	40	15	75	0.58
3	8	40	15	75	0.58
4	8	40	17	85	0.75
Low-achieving group		38		79	
5	9	45	16	80	0.64
6	9	45	16	80	0.64
7	9	45	16	80	0.64
8	10	50	16	80	0.60
Medium-achieving group		46		80	
9	11	55	17	85	0.67
10	11	55	17	85	0.67
11	11	55	18	90	0.78
12	11	55	18	90	0.78
High-achieving group		55		88	
Average	9	46	16	82	0.67

Table 1 shows the percentage of learning achievement test in which post-test was statistically higher than that of the pre-test. The average of student pre-test score is 46% while that of post-test score is 82%. Moreover, the class normalized gain is 0.67 which is at medium level.

3.2 The comparison of learning achievement between pretest - posttest and normalized gain by difference levels of achievement

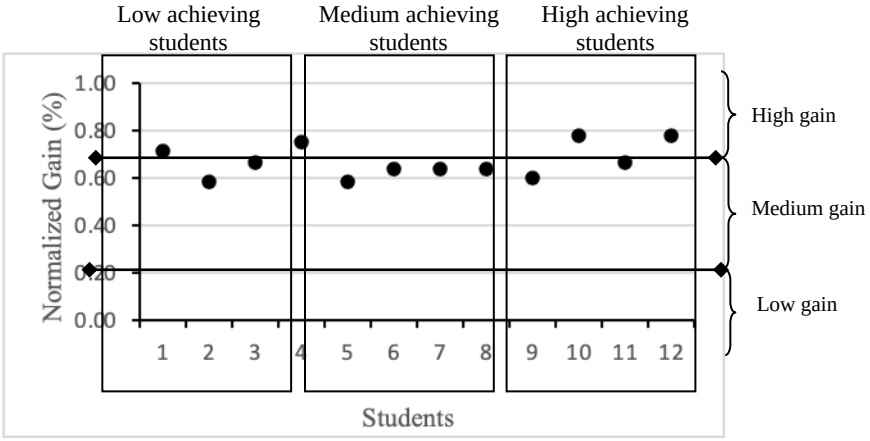


Figure 6. The normalized gain by difference levels of achievement

Figure 6 illustrates the percentage of normalized gain of students in 3 difference learning abilities. From the results, we found that two students in low group were able to develop their skills to be in the high gain. This could be concluded that our developed approach could help students gain more understanding of concept of computer assembly.

3.3 Students' Satisfaction toward Virtual Computer Laboratory

Table 2
The Results of Students' Satisfaction toward Virtual Computer Laboratory

Questions	Mean	Std. Dev. (SD)
The image is beautiful, clear, realistic.	4.25	0.52
The sound is clear.	4.17	0.70
Satisfaction with animation	4.33	0.53
Satisfaction with 3D models	4.42	0.53
Can be used easily	4.17	0.63
Get fun and enjoy	4.25	0.48
Get more knowledge about computer equipment	4.33	0.48
Get more knowledge of computer assembly	4.58	0.70
Able to recognize more computer devices	4.25	0.63
Understand how to build a computer	4.25	0.42
Total of satisfaction with virtual laboratories	4.17	0.67
Overall	4.29	0.60

Table 2 shows that the average of students' satisfaction was at the high level (Mean = 4.29, SD = 0.60). Form the results, we found that the highest satisfaction was *get more knowledge of computer assembly* followed by the *satisfaction with 3D models*, and *satisfaction with animation*.

3.4 Students' Computer Assembly Skills

The score, collected by the assessment forms, of computer assembly skills was compared between groups. The results, illustrated in Figure 7, show that all of the team score is higher than 70 percent which is the pass criteria. Figure 7 shows the comparison between team score and individual score.

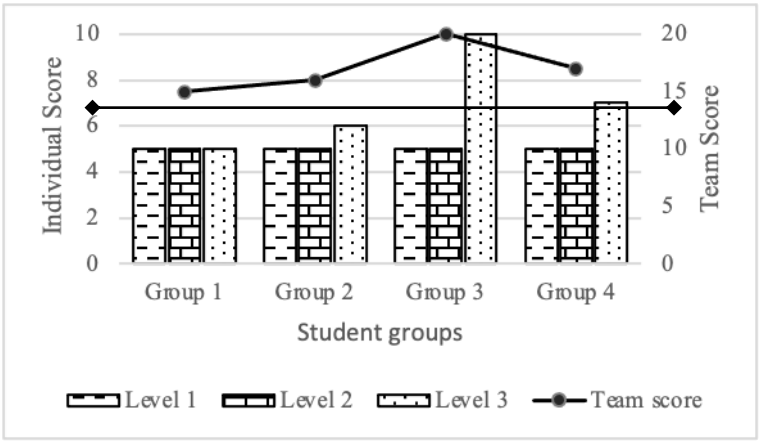


Figure 7. The comparison score between students' groups with criteria of 70 percent

4. Conclusion and Discussion

This paper is presented the using of virtual computer laboratory in conjunction with team game tournament learning method for 12th grade students. By using the advantages of virtual reality technology that can simulate computer laboratory and various computer equipment. The virtual reality technology allows the user to manage objects in virtual environment for training computer assembly skill. To promote learners to collaborate and to increase the challenge of learning, we integrate the team game tournament (TGT) learning approach to encourage students to have cooperative skill and helping each other to solve problems. The most important is that it leads to the development of learning achievement of learners better. From the result of this preliminary study, we found that all 3 achieving groups had a higher post-test score than pre-test, and the average of normalized gain was at the medium level. With virtual reality technology integrated with TGT approach, it enables learners who have different levels of learning skills to help each other and increasing the learning progress of low group to have a post-test score, equivalent to students in the medium and high groups.

Acknowledgements

The authors acknowledge the Project for the Promotion of Science and Mathematics Talented Teachers (PSMT), the Institute for the Promotion of Teaching Science and Technology (IPST), Ministry of Education, Thailand. They thank Mr.Ruengyos Soikeaw from Ubon Ratchathani University for assisting development of the virtual computer laboratory. The authors are also grateful to Faculty of Science, Ubon Ratchathani University for use of facilities.

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