Implementation of 3D virtual learning environment to improve students’ cognitive achievement

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Abstract. Virtual Learning Environment (VLE) has been widely used in assisting learning. This study aims to implement VLE-based learning in software engineering course. VLE provides many facilities for learning. In this research, VLE components used were presenter and quiz chair components. Evaluation results showed a significant difference from classical learning.

1. Introduction
Learning when viewed from cognitive is adding information to memory [1]. One outcome of learning is the cognitive value of students. The cognitive domain shows the extent of capability achieved from the lowest to the highest. Research on the use of learning methods to improve student cognitive has been largely done by teachers in the form of class action research. To improve students' cognitively, learning tools are needed such as learning materials (in the form of text, images, animations, video games and others) and assessment. For that, we need a learning mode with multimedia. Another important factor is students’ interest in the lesson.

The virtual learning environment (VLE) has been widely used to be an alternative to the physical environment. VLE has many functions to support learning [2]. VLE integrates Learning Management System (LMS) with student interface both second life [2], and OpenSim [3,4] via Sloodle. The use of 3D in VLE provides many advantages, especially the interaction between students and teachers through avatars, as well as collaboration among students [5]. In the era of 21st-century learning that focuses on the student centre, VLE provides the necessary mechanisms, such as constructivism, collaboration [6] [7]. Assessment is important in learning and in VLE provides real-time response using quizHUD [8] and provides challenges and a sense of competition among students.

VLE-based learning leaves less effectiveness in learning. This paper is intended to implement 3D VEL learning based on integrated author tool (LMS), Multimedia learning with 3D MUVLE, through Sloodle to generate interactive learning. The test was done on the software engineering class at Computer Science of Education Universitas Pendidikan Indonesia. Testing is done to know the Gain result of learning of two treatment which done. This test uses statistical methods so it can be seen the difference of results.

This research is organized as follows: introduction section contains problems encountered and research objectives. The related work section contains a track record of previous research on the issues
discussed. This section contains state of the art. Section of research method contains step research work consisting of research stages. Results and discussions section containing research results and explanations. The conclusion section contains the conclusions and work features.

Virtual Learning Environments (VLE) have been widely used in learning. VLE integrates LMS for author tools and 3D Virtual Environment for the learning interface through a middleware. VLE has facilities to support the learning process, such as presentation, quizihu, and others. The advantages of VLE are [2]:
1. Web-intercom: a chat-room that brings MOODLE chat-room and Second one together;
2. Registration booth: this tool links students’ avatars to their MOODLE user accounts;
3. Quiz tool and 3D dropbox: this tool which stands for assessment in Second Life and grades book in MOODLE sets quizzes or modeling tasks in grade book;
4. Multi-function toolbar: this tool enhances the Second Life user interface;
5. Presenter: this tool quickly authors SL presentations of slides and/or web pages on MOODLE;
6. QuizChair: This tool lets students attempt a standard MOODLE multiple-choice quiz inside SL, with the answers being stored on MOODLE.

The author tool is a component of VLE used to assist teachers in preparing learning materials and assessment. The author tool that is the most widely used in the MOODLE. While learning interface component can use second life [2,5,8,9] and OpenSim [3,4,7,10].

VLE is used in learning to add immersive, engage, and interesting students, especially in:
1. Provide pedagogical support to the lab by enabling to create online texts and delivering them to the students [3];
2. Provide face-to-face (F2F) interaction among students and their instructors in virtual world [5];
3. Provide a mechanism to incorporate constructivist, experiential, and student-centered learning practices into the classroom [6];
4. Give motivation for studying the potential of Virtual Worlds applications in education stems from the capabilities they offer to create a cyberspace where users can interact with other participants (through their avatars) or objects, creating new experiences that are not often feasible in the real world [10];
5. Can implementation cooperative learning although in virtual environment provide [4];
    - Provide multi-user system in the virtual environment [11].

2. Methods
The research method in this research can be seen in figure 1. It can be seen in figure 1 that the step is from 7 steps as follows:
1. Identification of problem: this step is the first step of the research to determine the problem (lack of student interest and students’ understanding of the lesson) and determine the purpose of research;
2. Study literature: the study conducted is a preliminary study in accordance with the existing problems. Furthermore, the study of literature to get the theory and technology that can be used to solve the problem;
3. Data collection: identify the data and collect the necessary data such as curriculum, teaching material, evaluation, and class profile;
4. Design model: designing learning models in virtual learning environment, such as avatar design, environment, and layout;
5. Development learning media: VLE-based media development. This development follows the stages: the design of media models, the development of learning media, the implementation of media on learning in the class, and validation in accordance with the test data;
6. Store learning media: the learning media is stored in storage so that it can be used in the future; Implementation learning media in class: implementation of learning using VLE and analysing learning outcomes.
3. Results and Discussion

3D VLE built in this research is the integration of author tools, middleware and student interface. The system architecture can be seen in figure 2. Seen in Figure 2 that the author tool has database and web services. The author tools are used for teachers in preparing lessons: learning materials and assessment. Middleware uses SLOODLE that serves as a bridge between author tools and student learning systems. While the student interface uses OpenSim and the viewer is the singularity.
Based on Figure 2, the student layer also has its own database and web service. In this research, VLE component used follows:

1. Registration booth: used to register the avatar to be a student/participant in MOODLE;
2. Presenter: used to display learning materials in a virtual environment;
3. Quizchair: used for assessment, in the form of multiple choice quizzes.

Learning begins when an avatar makes a registration at the registration booth for synchronization with class participants in MOODLE via login to the LMS. This step can be seen in Figure 3 and Figure 4. The teaching materials will be displayed through the presenter component and the avatar can learn them as shown in Figure 5. Evaluation is done after the learning is complete. Quizzes in VLE use the quizchair component where the avatar should sit on it then answer quiz questions. If the answer is correct, the seat will rise so that it will show healthy competition conditions among learners. Quiz atmosphere can be seen in figure 6.

Implementation of the system on classroom learning is done on software engineering course for semester 6 in Departement of Education Computer Science Universitas Pendidikan Indonesia. The learning atmosphere in VLE can be viewed in figure 7-10. Testing is done by performing two different treatments: classical learning and applying media in VLE.

Software engineering class consists of 17 students. The classes are divided into 3 groups based on preliminary evaluation results, namely: upper, medium and lower groups. Data analysis was done by using ANOVA method with significant level 5%. The analysis results show that $T_{calc} > T_{table}$ which means there is a significant difference to the use of VLE in learning the course. ANOVA analysis can be seen in table 1.
The T-test is done to know the difference between the mean both by calculating the gain. The analysis was performed on Tcal and Ttable as shown in table 2. From table 2, it can be seen that Tcal > Ttable can be concluded that there is a 95% confidence level for the significant difference between the initial value before the treatment and the final value after the treatment using VLE learning for students in the course of Software Engineering.

![Learning atmosphere](image1)

**Figure 7.** Learning atmosphere

![Interface of learning material (1)](image2)

**Figure 8.** Interface of learning material (1)

![Interface of learning material (2)](image3)

**Figure 9.** Interface of learning material (2)

![Interface of result learning](image4)

**Figure 10.** Interface of result learning

| Source variant | DB   | JK    | RJK   |
|----------------|------|-------|-------|
| Group (A)      | 2    | 1455.48 | 727.74 |
| In (D)         | 14   | 238.64 | 17.045 |
| total corrected (TR) | 16 | 1694.12 |

Tcount=42.69412 and Ttable=5.56

| No | ID | NAW | NAK | Gain | Xd  | Xd2   |
|----|----|-----|-----|------|-----|-------|
| 1  | N1 | 70  | 30  | -40  | -41.76 | 1744.29 |
| 2  | N2 | 70  | 60  | -10  | -11.76 | 138.41 |
| 3  | N3 | 60  | 60  | 0    | -1.76  | 3.11  |
| 4  | N4 | 60  | 80  | 20   | 18.24  | 332.53 |
| 5  | N5 | 50  | 60  | 10   | 8.24   | 67.82 |
| 6  | N6 | 50  | 60  | 10   | 8.24   | 67.82 |
| 7  | N7 | 50  | 40  | -10  | -11.76 | 138.41 |
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| No | ID | NAW | NAK | Gain | Xd   | Xd2   |
|----|----|-----|-----|------|------|-------|
| 8  | N8 | 50  | 60  | 10   | 8.24 | 67.82 |
| 9  | N9 | 50  | 40  | -10  | -11.76 | 138.41 |
| 10 | N10| 50  | 80  | 30   | 28.24 | 797.23 |
| 11 | N11| 50  | 50  | 0    | -1.76 | 3.11  |
| 12 | N12| 50  | 50  | 0    | -1.76 | 3.11  |
| 13 | N13| 50  | 30  | -20  | -21.76 | 473.70 |
| 14 | N14| 40  | 80  | 40   | 38.24 | 1461.94 |
| 15 | N15| 40  | 50  | 10   | 8.24  | 67.82  |
| 16 | N16| 40  | 50  | 10   | 8.24  | 67.82  |
| 17 | N17| 30  | 10  | -20  | -21.76 | 473.70 |

Tcount = 21.9089, Ttable=2.12

4. Conclusion
This study implemented learning in virtual environments. Addressing learning outcomes there are significant difference from the use of such media. This research is expected to contribute in improving the quality and innovation of learning but still leaves the problem of integration, because the system is not adaptive, such as quizzes and learning materials are still static. Furthermore research is to build an adaptive learning system in accordance with the character of students with implement machine learning.

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