# Interactive Distance Media Learning Collaborative Based on Virtual Reality with Solar System Subject

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*Abstract* - **The emergence of the Internet and various computer devices has revolutionized the learning process in various schools and colleges, both in terms of media and interaction methods. E-learning and distance learning is one of the revolutions of how education can be passed well through cyberspace media that are connected, organized, and integrated with each other. In this research will be developed distance learning media using virtual reality technology, where teachers and students can make communication and made an immersive learning process although they stayed in different places. However, they can have the same face-to-face conversation, sitting in one table, and made virtual meeting with their avatars like meet in the real world in space. As an example learning subject, this project will present solar system learning with interactive virtual reality media**

*Keyword: learning media, virtual reality, oculus rift, leap motion, collaborative learning, distance learning*

## I. INTRODUCTION

The process of teaching and learning in education has undergone many revolutions in terms of the use of instructional media or even on the methods used. From conventional times using whiteboards then switch to the medium the OHP highlight uses transparent paper, and today almost all the mainstream media of learning switch to LCD projector and LCD / LED display. In this research, we will conduct research and technological breakthroughs to help how distance learning can be presented in the practicum course with an immersive approach between faculty and students in the virtual reality realm, they will be brought into virtual space that seems correct Talk and sit in one room, and can demonstrate various visual media directly and interactively.

In another area, Facebook and Oculus Rift have collaborated in developing this topic with VR Social Network. With this feature, Facebook users have possibility in virtual meeting with their friends. They can communicate face to face each other with their avatars using oculus headset. This project mock-up as shown in Figure 1.
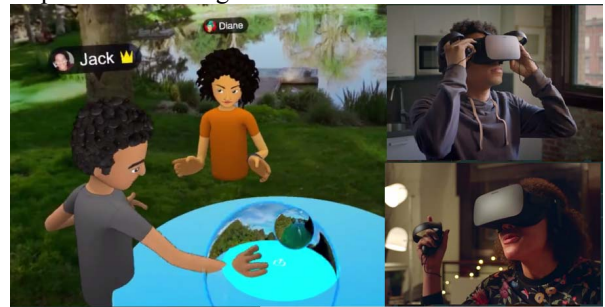


**Fig 1.** VR Social Network's feature interaction in facebook *(source: oculus.com)*

So, in this research development, multi-user VR technology will be examined to be an interactive medium for Distance Learning for practicum / lecture subjects that require props. As an early demonstration will be made virtual display media on learning the material of the solar system using the concept of adventure games based on VR and multiuser technology. Teachers and students who are in the distance even will be reunited in one area that is complete with the virtual solar material performances are complete with animation, although long distance and only meet in the virtual world, the teacher will be able to move more freely explain the various existing viewer, As well as the student will be able to 'touch' the display and can make a very immersive interaction through his own avatar in the world. To be able to achieve high immersive level, this application media will be equipped leap motion hand movement sensor that can control the movement of each user's hand (user), either teacher or student.

IEEE computer society

## II. RELATED WORKS

### A. Interactive of Learning Media

In the process of teaching and learning on the classroom, media is a tool which serves to channel the messages of knowledge in the perspective of learning from the teacher to students to achieve the effectiveness of instruction [1]. The smoothness of the learning model is also determined a bit by the learning media used. Some experts provide a definition of instructional media that the use of instructional media in both quantitative and qualitative research is also an important measure in the process of proving hypotheses.

Brown reveals that, "learning media used in learning activities can affect the effectiveness of learning"[2]. At first, learning media only serves as a teaching tool for teachers as visual aid. So around the middle of the 20th century the visual utilization effort was supplemented by the use of audio tools, so that was born an audio-visual aids. Then in line with the development of science and technology, especially in the field of education, currently the use of tools or learning media becomes increasingly widespread and interactive, such as the presence of computers and the Internet.

### B. VR as Collaborative E-Learning Media

Virtual Reality (VR) is a technology that allows a user to interact with a computer-simulated environment, whether the environment is a simulation of the real world or an imaginary world [3], so using VR technology which is supported by many sophisticated 3D simulation devices, interacting inside VR is similar like interacting in real world physically.

Though VR technology was developed since 1960s, nowadays the development of VR has been implemented massively because implementation of VR is getting cheaper and easier to get. Most of today's implementation of VR technology are used for video interaction, games, mastery testing / training (like flight simulator, driving simulator, or skydiving simulator), virtual tour of places, and one of the new one is social VR interaction.



**Fig. 2.** One of USA's Navy and Marine corps aviators is using Virtual Reality device for skydiving training [4]

With Social VR idea, Teresa Monahan, Gavin McArdle, and Michela Bertolotto have created CLEV-R as e-learning

collaborative media based on website [5]. Although this project hasn't used headset, but feels of interaction and collaborative learning environments were happened. A suite of communication tools provide text-chat, voice communication and facilities for students to broadcast directly from their web-cam into the 3D environment. In this research, students can also share their own personal files by uploading them. Thus, CLEV-R provides a general interface to e-learning. The environment mimics a real university consisting of a lecture room, a number of meeting rooms, and avatar of their characters were provided in this system [5]. Figure 2 shows the *screenshot* of CLEV-R which has built for e-learning VR based on web.
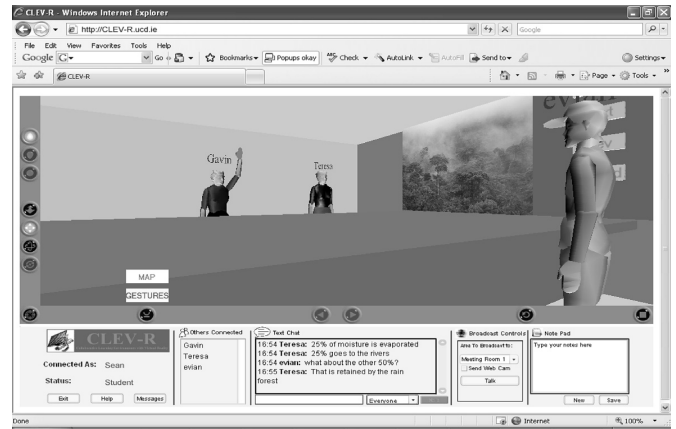


**Fig. 2.** One of Collaborative VR e-Learning, namely CLEV-R which as purposed for distance collaborative learning based on web [5].

CLEV-R was designed into website based, in order that effectivity's use of users could be handle by practice, without installing the specific application anymore. They just need to open browser from any devices, either desktop or smartphone. Thus, evaluation and discussion features ware also provided in this application. Figure 3 as showed the communication's process and student-assignment feature which is run under mobile/PDA.



**Fig. 3.** Use of CLEV-R in mobile version [5]

## C. Virtual Reality for e-Laboratory

In the recent researchs, Virtual Reality (VR) was also implemented into virtual practicum in laboratory. This project presents 3D virtual reality with hand gesture interaction for education. With this media, student could accomplish his practicum without worry anymore about insecurity in labs because of dangerous chemicals materials, crowded classrooms, lack of time, lack of materials, cost of equipment, and also incapableness of teachers and so on.

Labster is one of the corporate which is concern in laboratory VR development [6]. Labster has been made several laboratories simulation based on virtual reality with hand gesture interaction. Labster also collaborate with several excellent universities in the world in developing those tools of VR-laboratory simulation. Figure 4 shows one of VR-laboratory in work safety practicum.



**Fig. 4.** Virtual Reality in Work-Safety Laboratory which was developed by Labster [6]

In another development, Sritrusta Sukaridhoto, at al. [7] have developed 3D Virtual Reality Chemistry Laboratory. This simulator was constructed using two main equipment, there are *Oculus Rift* and *Leap Motion*. Oculus Rift is VR headset which used for displaying objects in its virtual laboratory and leap motion is used for detecting user's hand-gesture orientation to interact with him.

With this application, user will fill immersive world in virtual laboratory. He can see and interact with any equipment inside its laboratory. He can do procedural practicum with reference work likes in the real world. Furthermore, with this application we can avoid several basic problem in the school, like absence of chemistry labs, insecurity in labs because of dangerous chemicals, crowded classrooms, lack of time, lack of materials, cost of equipment, and also may be due to incapableness of teachers in using labs effectively and their negative attitudes towards laboratory applications [8]. Figure 5 showed how virtual chemical laboratory based on VR works.
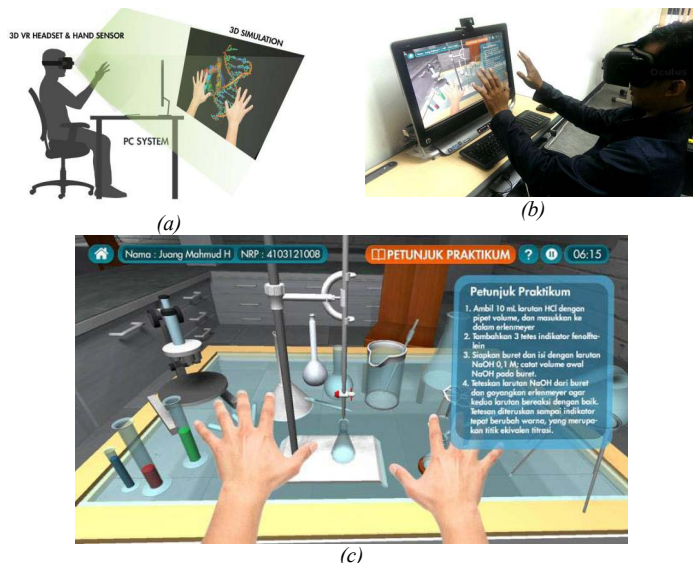


**Fig. 5.** Virtual reality laboratory of chemistry: (a) system design, (b) user simulation, (3) user interface and work guidance [7]

## III. SYSTEM DESIGN

In this system design, we create this application focused to construct communication, connection, and sharing objects at one space of virtual world. So, the main idea is how a teacher can interact to their student with very immersive situation likes in reality (virtual reality). So, Figure 6 showed a system design of VR (Virtual Reality)'s distance learning media.
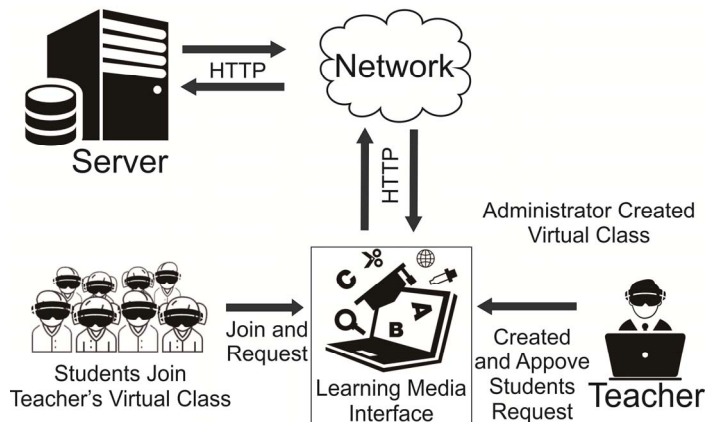


**Fig. 6.** System Design of VR's Distance Learning Media

The student or teacher determines the choice of learning on the initial menu, then the media will take him to the interactive learning scene, in this section will be explained about how interactive learning takes place.

a) Teacher (Server), teacher can make the host server to connect the device to an existing connection. Then automatically IP address is set in the media, so no need to reset. Then after creating the host (venue), the teacher will be

positioned on a predetermined planet. Then the student will follow where his teacher is on what planet. Thus, both of them can interact each other.

b) Student (Client); student will join the host server by connecting the device to an existing local connection. Then automatically IP is set in the same media. Then after connecting with the host / study room, students will be positioned on a planet that has been determined by the teacher.



**Fig. 7.** User Interface connection

In Figure 7 showed an examples of User Interface (UI) which is applied into this learning media. With this UI, teachers and students will be connected by creating the room and invite another member (students) to join the subject's learning.
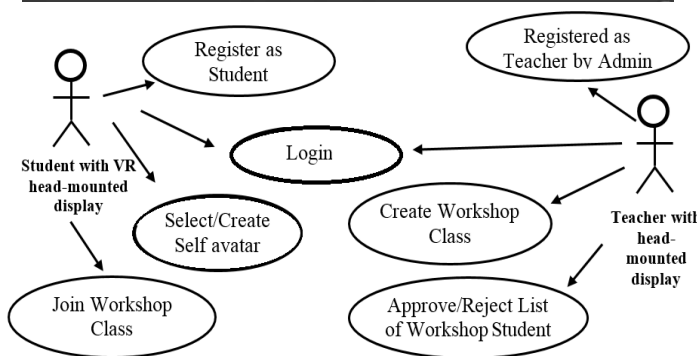


**Fig. 8.** Prototype simulation and Use Case of Teachers and students at the real-time of VR collaborative learning

In Figure 8 there was a pseudo-3D picture of teachers and students when interacting in one place. With this media, teacher and students will be able to explore freely within a planet or in one of the members of the solar system

## IV. EXPERIMENT AND ANALYSIS

With exanimate this system to several students in junior high school, we collect several experiment result which showed how interactive and effective this media learning has delivered to them. Figure 9 is showed one of student is trying this media.



**Fig. 9.** Student is trying this VR media learning

From this experiment, students are using instructional media and observing the planets in the solar system. Students can view the solar system virtually using oculus rift and can interact with leap motion.



**Fig. 10.** Preview of the learning media

There was a self-learning view using Oculus and Leap Motion VR devices. With a view, the planet looks like it looks real in front of the user. Media users can also control the media

to display the desired planet using Leap Motion.

## A. User Interface (UI) Design

In this part, we design this learning media with three interactive UI, they are *Splash Screen, Main Menu and Loading Screen*. This menu can be accessed by touching it with virtual hand which is tracked by leapmotion controller sensor. Figure 11 showed several preparation UI before enter to the main learning.
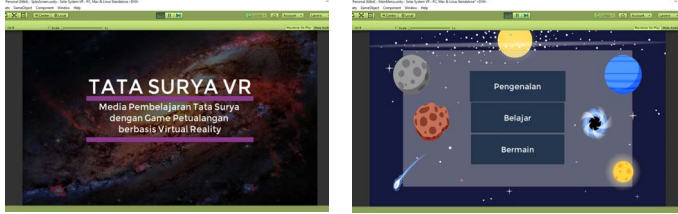


**Fig. 11.** Preparation UI of This Learning Media

## B. Multiplayer Interactive Learning

We use network manager in unity engine to connect this interactive media. So, in this experiment, teacher was set his host's network to IP address 127.0.0.0 or localhost with port 7777. This address and port number will be appear in client's connection UI when accessed. Figure 12 showed network status of server and its client.
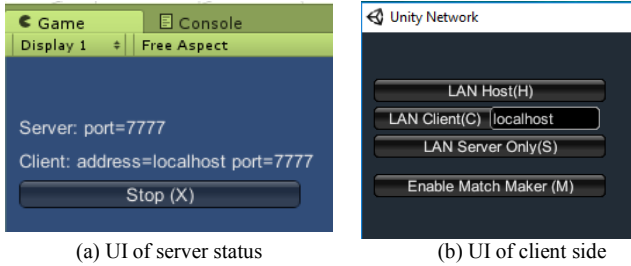


(a) UI of server status      (b) UI of client side

**Fig. 12.** UI of network connection's status

After client and server are connected, both are located in one placed which was decided before. So, the teacher will see his hand and human avatar in front of his headset which is represented as student. Vice versa, in another side, the student will see his virtual hand which tracked by his leap motion and one human avatar in front of him which is represented as teacher. Figure 13 showed a prototype design of collaborative virtual class or discussion forum with multiplayer.



**Fig. 13.** Collaborative virtual class with multiplayer approach

## C. Product Analysist

In this media experiment the authors take several samples of data to be analyzed, the method used is a questionnaire method. Where students answer some questions. The questionnaire has a category of questions as Table 1.

TABLE 1. Result of Respondent's Feedback

| N o | Value | Amount of respondent's answer | | | Total respondents |
|---|---|---|---|---|---|
| | | *Good* | *Enough* | *Less* | |
| 1 | **Solar system understanding** *question 1* | 22 | 5 | 5 | 32 |
| 2 | **Solar system visual aid** *question 2* | 26 | 5 | 1 | 32 |
| 3 | **Subject understanding** *question 3* | 25 | 7 | 0 | 32 |
| 4 | **UX Media** *question 4* | 25 | 5 | 2 | 32 |
| 5 | **Interesting** *question 5* | 24 | 8 | 0 | 32 |

From the questionnaires undertaken by this survey, there are major issues that should be part of the survey on the respondents. These sections are knowledge of the solar system, the search for a tool, the material understanding, the ease of using the media and the students' interest in this learning medium.
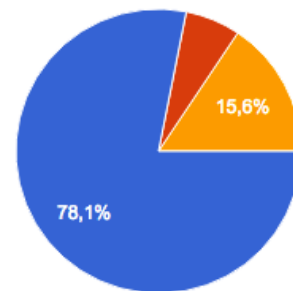


**Fig. 14.** Result of the ease of use

As showed in Figure 14, the results of the questionnaire can be inferred for the use of this medium that 78,1% says that the medium is easy to use, 15,6% says that the medium is enough to use and 6,3% says that the medium is hard to use.

## V. CONCLUTION

Interactive Learning Media in Solar System Subjects with Virtual Reality experience will greatly impact to learning of solar system. With virtual reality, subject could be simplify delivered to the user in conducting studies of solar system. Also implements learning of solar system inventor in the media of PC desktop with the aim of helping the student to be able to use it more efficiently. This learning application is built on the Mac OS platform which can be downloaded in the itch.io or file sharing place for free and then the application can be used offline for accessing without resource from outside of the system.

This medium facility is an implementation of interactive distance education, teachers and students do not have to be in the same place. They can interact with each other even if they are in a place far away. The learning of the solar system goes well like learning in general.

In addition, this medium can accommodate more users. Many students can interact comfortably. Working with educational institutions so that this medium can be used by anyone who needs. Viewing the media is beneficial to increase the level of students' curiosity about the solar system

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