23 (2), 2022, 642-650

Jurnal Pendidikan MIPA

e-ISSN: 2550-1313 | p-ISSN: 2087-9849

http://jurnal.fkip.unila.ac.id/index.php/jpmipa/

Students' Understanding of Climate Change after Learning using Immersive Virtual Learning

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Abstract: Immersive Virtual Learning is a learning that is considered meaningful for students to learn the complex concept of climate change because of the many interactions of the systems involved in it, and is considered a concept that is quite challenging for students. It is known that there are still many students who have limited knowledge about climate change so that learning methods are needed that can help them understand the concept of climate change well. This study aims to see how students' understanding after learning using the Immersive Virtual Learning method, and compared with conventional learning methods. Using the Pre-Post Experiment Control Group Design involving 59 students who were divided into treatment and control classes, resulted in data showing that students' understanding in the two classes experienced a significant difference, but very small improvement, even though the treatment class experienced a better improvement. than the control class. Based on this, it can be concluded that students' understanding has increased slightly after learning to use the Immersive Virtual Learning method.

Keywords: immersive virtual learning, understanding, climate change.

Abstrak: *Immersive Virtual Learning merupakan pembelajaran yang dinilai bermakna bagi siswa untuk mempelajari konsep perubahan iklim yang kompleks karena banyaknya interaksi sistem yang terlibat di dalamnya, serta dianggap menjadi konsep yang cukup menantang bagi siswa. Diketahui masih banyak siswa yang memiliki pengetahuan terbatas mengenai perubahan iklim hingga diperlukannya metode pembelajaran yang dapat membantu mereka memahami konsep perubahan iklim dengan baik. Penelitian ini bertujuan melihat bagaimana pemahaman siswa setelah belajar menggunakan metode Immersive Virtual Learning, dan dibandingkan dengan metode pembelajaran konvensional. Menggunakan desain Pre-Post Experiment Control Group Design dengan melibatkan 59 siswa yang dibagi ke dalam kelas eksperimen dan kontrol, menghasilkan data yang menunjukkan bahwa pemahaman siswa di kedua kelas mengalami perbedaan peningkatan yang signifikan, namun sangat kecil, meskipun kelas eksperimen mengalami peningkatan yang lebih baik daripada kelas kontrol. Berdasarkan hal tersebut, dapat disimpulkan bahwa pemahaman siswa mengalami sedikit peningkatan setelah belajar menggunakan metode Immersive Virtual Learning.*

Kata kunci: *immersive virtual learning, pemahaman, climate change.*

▪ INTRODUCTION

Climate change is a serious problem that is becoming a concern for various groups of people around the world because this problem is said to be a problem that determines the continuity of the times (Dimitrov, 2010). Involving children to participate in understanding climate change is a goal that needs to be realized for future survival (Kolleck, 2016). Environmental education, particularly an understanding of global warming and climate change, needs to be provided to students as the younger generation so that they can make policies and decisions, as well as take appropriate actions to

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DOI: http://dx.doi.org/10.23960/jpmipa/v23i2.pp642-650
Received: 29 April 2022
Accepted: 16 June 2022
Published: 09 July 2022

address these problems (Cutter-Mackenzie & Rousell, 2019). But unfortunately, knowledge of the community and students about the concepts of climate change is still limited (Riess & Mischo, 2010). It was further explained that the complexity of the concept of climate change was one of the causes of the students' lack of understanding of climate change. Students tend to only understand oneway causal relationships in climate change systems, even though climate change is a concept in which there are complex system relationships. Therefore, knowledge about climate is the basic thing that students need to understand (Crop et al., 2012).

Students' knowledge about the issue of climate change is an essential thing that needs attention because how much knowledge they have will determine how much they contribute to preventing climate change (Assan, 2015). Decisions and policies are taken by students as a form of participation of the younger generation in dealing with the impacts of climate change (Barab et al., 2005). Therefore, teachers need to understand students about climate change in the best possible way. It is widely recognized that innovative and effective forms of climate change education are needed by students around the world (Selby & Kagawa, 2010). Climate change education requires a student-centered focus and includes a relevant, challenging, and meaningful personal context (Monroe et al., 2019).

Virtual Immersive Learning (IVL) is considered to be a meaningful form of virtual (distance) learning. According to the research results of Markowitz et al. (2018) shows that students who have used IVL have increased knowledge and curiosity about climate change, in addition, students also show more positive attitudes towards the environment. The same thing was also shown in the research of Parong & Mayer (2021), in addition to experiencing an increase in learning outcomes, students also experienced an increase in their learning motivation. The immersive experience in IVL requires empirical evidence-based scientific design principles. Virtual field trips or Virtual Field Trips are considered to be learning that might improve learning outcomes and add meaningful experiences for students (Klippel et al., 2020).

Field trips are a means to develop skills, integrate knowledge, and prepare students for lifelong learning (Zhao et al., 2020). Due to the success of technology-based learning reported in several previous studies, this makes virtual field trips considered an effective form of learning to visit the actual field, especially in certain conditions it is difficult to explore a certain place. According to Cheng (2021), in VFT (Virtual Field Trip) which means the need for real content with students accompanied by interesting content designs, because with this it can be experienced, increase motivation, make it easier for students to understand abstract concepts, and encourage learning. inquiry. It was further explained that apart from VFT, immersive learning requires collaboration. Ojala (2016) suggested that apart from involving local problems, he also suggested that children be involved with the community to overcome these problems. The participation of children is one of the important things on the path to a sustainable future (Trott, 2019).

With the background of some of these problems, the author wishes to provide meaningful learning to students in the form of Immersive Virtual Learning (IVL). The Covid-19 pandemic period has completely changed the way students learn around the world, so there is a need for innovation in learning methods that are meaningful but can be applied without distance restrictions. According to Markowitz et al. (2018), students

who have used IVL have increased their knowledge and curiosity about climate change. The same thing was also shown by Parong & Mayer (2021), in addition to experiencing an increase in knowledge, students' learning motivation also increased. Therefore, in this study, the researcher wanted to find out how students understand climate change after learning to use the Immersive Virtual Learning method.

▪ METHOD

The design used in this study is a pretest-posttest control group design which is one type of research design in the Quasy Experimental Research method. The character of this design is that the participants are not chosen randomly and the group is given a pretest and posttest. The participants in this study were 59 students from two classes in grade 7 of a junior high school in Lamongan Regency, East Java. The selection of participants could not be done randomly because the researcher followed the advice and approval given by the school. The data is obtained from the value of understanding questions done by students, the questions were developed by the researchers themselves and have gone through various stages of trials

Before learning begins, the pretest is given first in the treatment and control classes. After that, the treatment class will conduct learning using the IVL method, in which students carry out many activities, including conducting experiments on the greenhouse effect as an effort to understand students about the process of climate change starting from global warming. Observing the Virtual Field Trip (VFT) video was also done by the students after the experiment. The video is given to students with the intention that students can find out in real terms the climate change that is happening, both in the world and in the environment around students. The video contains evidence of climate change in the form of impacts and shows some of the causes. Together with their groups, students answer questions based on their observations of the VFT video. In addition, students are also assigned to observe the conditions around their homes related to the causes and impacts of climate change.

Webinars with NGOs working in the field of climate care (Greenpeace) are also used by teachers as a way to understand students about climate change. While listening to the presentation from the presenters, students answered the questions that had been provided to the Students' worksheet to guide students in understanding the material presented by Greenpeace. After the webinar is over, students are invited to ask questions and discuss with the presenters about climate change material which is delivered more contextually by the presenters. During the learning process, the teacher also uses the lecture method as a complementary activity to explain the material to students and to complete their understanding of the results of carrying out several activities in IVL.

As for the control class, learning is done using group discussions and lectures by the teacher. Most of the time the control class is used by students to discuss problems that occur due to the impact of climate change. Student discussions are guided by the Students' worksheet that has been provided by the teacher. The lecture method is also used by the teacher to provide a complete explanation of what students are doing and the topic of climate change. After all the series of learning activities have been completed, the teacher then gives a posttest in the treatment class and control class. The analysis of understanding data obtained from the pretest and posttest was carried out using the SPSS application. Descriptive analysis was first carried out on the pretest data.

Because the results of the pretest showed a significant difference between the treatment and control groups, the next step the author took was to analyze the gain value of each treatment and control class to see how much difference or improvement occurred in the two classes.

▪ RESULT AND DISSCUSSION

Understanding climate change is students' understanding of the concepts contained in climate change, both its causes, processes, and impacts. Learning about climate change is considered a challenging concept for students because it involves complex system interactions (McNeal et al., 2014). Students' knowledge of climate change is an important thing that influences their contribution to preventing the occurrence of more severe impacts of climate change (Assan, 2015). Unfortunately, based on the results of previous studies, it was shown that there were still many students who had limited knowledge about climate change (Riess & Mischo, 2010). This is in line with the results of this study which shows that students' knowledge about climate change is still limited, even with the increase in their knowledge after doing Immersive Virtual Learning (IVL) and conventional learning. Both showed unsatisfactory results, both the treatment class and the control class showed a not-so-large increase. These results are shown in Table 1, where the average gain in the treatment class is only 15.52 and in the control class is only 09.17.

Table 1. Results of pretest and posttest analisis analysis

Data Type		Pretest		Gain	
		Experimen	**Control**	**Experimen**	**Control**
Total Students		29	30	29	30
Average		62.07	50.67	15.52	9.17
Standar Deviation		11.535	7.279	8.488	3.957
Mann Withney Test	Sig.	0.000		0.000	
	Inter.	Significantly Different		Significantly Different	

The results of data analysis in Table 1 show that the pretest and gain values are not normal and not homogeneous, so the average difference test is carried out with the Mann-Withney test. The table shows that the pretest scores of the students in the treatment class and the control class showed significantly different results. Therefore, the writer then conducted a test on the students' gain scores in each treatment class and control class. The results of the gain calculation show that the two classes also experience significant differences, with an average gain in the treatment class of 15.52 and in the control class of 09.17. The difference in the mean of these two classes indicates that the treatment class experienced a greater average increase than the control class. That is, students in the treatment class get better learning outcomes than students in the control class.

This can happen because students in the two classes do learning in different ways. Students in the treatment class used the Immersive Virtual Learning (IVL) method to learn about climate change, while the control class used the usual learning methods in the class, namely group discussions and lectures by the teacher. IVL learning can improve student learning outcomes because it can guide students in learning concepts efficiently (Rao & Saha, 2019), and can provide new knowledge to students in the form

of visual information (Huang et al., 2020). The results of previous studies show that IVL learning can increase students' knowledge (Petersen et al., 2020). This is because immersive learning is designed to create an interesting, collaborative, and participatory experience for students (Dawley & Dede, 2014) and makes it possible to show a process that lasts a long time becoming shorter so that students can simulate a process that occurs for days, weeks. -weeks, even years, in seconds (Gee, 2000), compared to conventional learning. This learning is appropriate to be applied in teaching climate change material, which is a process that takes a long time and the concept is quite abstract.

The learning carried out in the control class was considered not to be better used to teach climate change material, because the average increase in student scores in that class was smaller than students in the treatment class. This happens because the students' work in groups is not optimal. In fact, according to Sachmpazidi et al. (2021), the success of group work is determined by how well the participation of each member is. In addition, the questions on the Students' worksheet are not relevant to the case readings provided, so students feel confused in answering them, and finally, students who have quotas can look for answers on the internet, while students who do not have quotas just stay silent and wait for answers from their friends. Inadequate internet access is one of the inhibiting factors for learning (Handayani* & Jumadi, 2021).

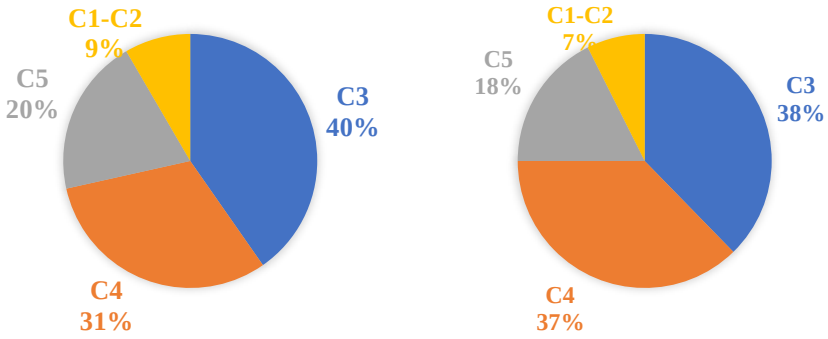
Although both classes experienced an increase in learning outcomes, both showed a fairly small increase. This shows that students' knowledge of climate change is still limited. The same thing is also found in the results of research by Lambert et al. (2012) which shows that students still do not have enough knowledge about climate change and there are even misconceptions about the basic concepts of climate change (Caranto & Pitpitunge, 2015).

The low increase in student knowledge is caused by several things, one of which is due to obstacles in the learning process that can affect the learning process and outcomes (Handayani & Jumadi, 2021). Some of the obstacles experienced by researchers are the first, the limited time to study in class. Teachers need sufficient and flexible time to teach science to students (Tan, 2018) and time has an important role in learning, especially if it is integrated with technology (Tawfik et al., 2021). The second obstacle is the students' lack of concentration on the teacher's explanation because of the games on the students' gadgets. Meutia et al. (2020) said that addiction to playing games can affect students' interest in learning.

The third obstacle is that the students' work in groups is not maximal. Most students only rely on 1-to 2 people to do assignments and others cheat. Whereas success in achieving good group work results comes from balanced cooperation between each group member (Sachmpazidi et al., 2021). The next obstacle is another tactical constraint. Therefore, preparing learning tools is an important thing that must be done by teachers before carrying out learning, because well-planned learning will be carried out well (Widyanto, 2020).

The level of difficulty of the test questions also determines the success of students in answering these questions. Based on the results of the posttest data analysis of the treatment class and the control class (Figure 1), it is known that there are many incorrect questions on questions with cognitive levels C3-C5. These questions are complex and require higher-order thinking skills (HOTS) because students' unfamiliarity with

working on HOTS questions makes it difficult for them to work on questions. Referring to the results of the analysis, it can be seen that students' higher-order thinking skills are still lacking. The same results were also found in the research of Hartatiana, Wardani, and Megawati (2020) which said that the majority of students had low high-order thinking skills, especially in terms of evaluating, one of which was because students were not accustomed to working on test questions with the HOTS category (Irawati, 2018).



A. Experimental class B. Control class

Figure 1. The proportion of the number of posttest errors

Students' higher-order thinking skills need to be honed again by improving their learning styles (Di et al., 2019). According to Abdullah et al. (2021), technology-based learning tools can improve students' higher-order thinking skills. However, this can happen if students can use it as optimally as possible (Pletz & Zinn, 2020), because in fact, in this study the use of technology in immersive virtual learning was less than optimal in training students higherorder thinking skills and understanding climate change material. The technology used in immersive learning is not something that can improve learning outcomes universally, but only applies to certain fields (Beck, 2019) and if applied effectively (De Back et al., 2021). Therefore, it is necessary to make significant improvements to the Immersive Virtual Learning (IVL) method to obtain better results in the future.

▪ CONCLUSION

Based on the results of data analysis and further discussion on student understanding data after learning using the Immersive Virtual Learning method, it can be concluded that students' understanding of climate change has increased, and the increase in understanding that occurs in students in the treatment class is significantly different. Students in the treatment class experienced an increase in understanding of climate change which was better when compared to the increased understanding of students in the control class. Although both classes experienced an increase in learning outcomes, both of them experienced a not so large increase, so it can be said that students' understanding of climate change, both in the treatment class and in the control class, was still limited and needed to be improved again using more effective learning methods, or use the IVL method after further development and refinement.

Immersive Virtual Learning is not optimal in increasing students' understanding of climate change because there are several internal and external factors affecting students' learning processes and outcomes. Some of these internal factors include the concentration and motivation of students learning less than the maximum because the concentration of students is divided by the games contained in the gadget, student participation in group work is also less than optimal so that cohesiveness and teamwork are less effective, and others. Some external factors that influence the learning process are the limited time teachers have to teach inquiry-based climate change materials. The limited-time made the teacher not have the opportunity to explain more deeply about climate change material, especially those related to the results of experiments conducted by students. The next external obstacle is technical constraints, namely the lack of internet network facilities and the nonfunctioning of learning facilities when they are used, so that this can hinder the teaching and learning process in the classroom and will then have an impact on student learning outcomes.

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