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Project-Based Learning and Problem-Based Learning in Improving Climate Change Literacy of Junior High School Students in Disaster-Prone Areas

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Abstract: Climate change literacy must continue to be taught from an early age to students in the city of Kupang related to the impacts of climate change that occur, namely the tropical cyclone and the reduction of the coastline. This study aims to increase knowledge and beliefs about climate change that is currently happening so that students can take real action and have a positive impact on the environment where they live and the wider area. Learning by involving related networks, namely the Meteorology, Climatology and Geophysics Agency (BMKG) and experience-based learning using the Project Based Learning (Experimental Class) and Problem Based Learning (Control Class) methods can improve climate change literacy for class VII students (n = 60 people) in SMP Negeri 8 Kupang. The research was designed using a quasi-experimental method. Research instruments in the form of questions and questionnaires were used to collect data about students' knowledge and beliefs about climate change. The learning model based on experience can increase students' knowledge.

Keywords: climate change, project based learning, problem based learning.

Abstrak: *Literasi perubahan iklim harus terus diajarkan sejak dini kepada siswa di kota Kupang terkait dampak perubahan iklim yang terjadi yaitu siklon tropis dan berkurangnya garis pantai. Penelitian ini bertujuan untuk menambah pengetahuan dan keyakinan tentang perubahan iklim yang sedang terjadi sehingga mahasiswa dapat melakukan tindakan nyata dan memberikan dampak positif bagi lingkungan tempat tinggalnya dan wilayah yang lebih luas. Pembelajaran dengan melibatkan jaringan terkait yaitu Badan Meteorologi, Klimatologi dan Geofisika (BMKG) dan pembelajaran berbasis pengalaman menggunakan metode Project Based Learning (Kelas Eksperimen) dan Problem Based Learning (Kelas Kontrol) dapat meningkatkan literasi perubahan iklim bagi siswa kelas VII (n = 60 orang) di SMP Negeri 8 Kupang. Penelitian ini dirancang dengan menggunakan metode eksperimen semu. Instrumen penelitian berupa pertanyaan dan angket digunakan untuk mengumpulkan data tentang pengetahuan dan keyakinan siswa tentang perubahan iklim. Model pembelajaran berbasis pengalaman dapat meningkatkan pengetahuan siswa.*

Kata kunci: *perubahan iklim, pembelajaran berbasis proyek, pembelajaran berbasis masalah.*

▪ INTRODUCTION

A Tropical Cyclone Storm is a convective event that occurs in the waters (oceans) around the tropics, namely the area around the equator which ranges between 230 North Latitude (LU) and 230 South Latitude (LS), where a low-pressure system with a synoptic scale that grows over warm waters and a minimum wind speed of at least 63 km/hour over half the area surrounding its center, and lasts at least six hours (Syaifullah, 2015). Tropical Cyclone Storm in NTT Province, especially in Kupang City, occurred on April, 2021 (Kaho, 2021). Tropical cyclone Seroja caused many casualties, both life, and material casualties.

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The beach is an area of interaction between land, seawater, air, and the constituent materials in it that occur dynamically (Bunganaen et al., 2019). This interaction causes the coast to be vulnerable to changes in the form of shoreline reduction. Sea waves are the main parameter that causes changes in shorelines. The beach is also an area on the edge of the water that is influenced by the highest tides and the lowest tides. The length of the coastline in the city of Kupang is 9.5 km. According to the River Basin II Center, the Sub-Directorate of Coastal Security 2016 determined that along the coastline of the city of Kupang there were six critical points (Bunganaen et al., 2019). Along the coastline from Namosain Beach to Oesapa Beach, the coastline has been reduced. Global warming is a process of increasing the average temperature of the atmosphere, sea surface, and earth's land (IPCC, 2007). The global average temperature on the Earth's surface has increased by 1.2°C since the industrial revolution which began in 1850–1900. The climate model used as a reference by the Intergovernmental Panel on Climate Change (IPCC) project shows that global surface temperatures will increase by 1.1°C to 6.4°C between 1990 and 2100. Based on the explanation above, the authors feel it is important to teach material about climate change so that students have knowledge and awareness about the impacts of climate change that are currently happening. The study of climate change is an outgrowth of the study of the environment (Roth, 1992). The purpose of studying climate change is to develop students' knowledge and beliefs about climate change and the ability to mitigate climate change that occurs (Marzetta, 2017). Reducing human vulnerability to the effects of climate change depends not only on the ability to understand the science of climate change but also on the ability of students to integrate that knowledge into real action in society (U.S. Global Change Research Program, 2009).

Learning based on experience or known as Experiential Learning is an approach or strategy used in learning to grow students' scientific attitudes towards a material being studied (Widodo, 2021). Experiential Learning is a learning model that can be described or identified with "adventure education", "outdoor education", "challenge education", and "environmental education" (Roberts, 2013). The Experiential Learning model emphasizes a holistic learning model in the learning process, where experience has a central role in every activity. Teachers who can place students as active learners, the teacher succeeds in creating passionate learning, where students will try to find sources of information and have the initiative to act so that in the end the teacher provides opportunities for students to find solutions to solving a problem (Kim, 2018).

Based on previous research, it was found that the ability of students to solve problems begins with finding phenomena that occur or finding facts directly by students, validating using reliable sources of information, looking for solutions, and finally taking real action to solve the problem (Siegner, 2018). To get valid evidence, both phenomena and real conditions, students can use self-recorded videos, photos, and news from reliable print or electronic media. If students themselves experience phenomena or facts about the environment that occur as a result of climate change and students continue to try to find solutions and take concrete actions, then this learning experience will leave an imprint on the students (Marzetta, 2017).). Real correct actions from students in dealing with climate change are the result of correct knowledge about climate change and strong beliefs about the adverse effects of climate change.

In learning activities, the Experiential Learning model is more suitable to be applied in the subject matter about ecology and the environment, for example, the material on climate change. Learning based on experience or Experiential Learning can be expressed in several forms of learning activities, namely as follows: conducting field visits, working cooperatively in groups to complete a project given by the teacher, volunteering in a community when working on a particular project or problem, solving experiments in laboratories and activities involving other experiences. The role of the teacher in this Experiential Learning model is how the teacher places students as active learners (Kolb, 2017). Teachers must ensure that students experience firsthand all phenomena according to the material being studied.

The application of the Project Based Learning (PjBL) method in science learning can shape the knowledge, attitudes, and actions of students towards the material or subject matter that is being experienced (Rule, 2009). Project Based Learning (PjBL) according to Grant (2002) explains that Project Based Learning or project-based learning is a learner-centered learning model to conduct an in-depth investigation of a topic (Karpudewan, 2017). Students constructively carry out deepening learning with a research-based approach to problems and questions that are weighty, real, and relevant. Goodman and Stivers (2010) define Project Based Learning (PjBL) as a teaching approach that is built on learning activities and real tasks that provide challenges for students related to everyday life to be solved in groups (Sugiharto, 2020). Project-based learning is a learner-centered learning model and provides a meaningful learning experience for students. Students' learning experiences and concepts are built based on the products produced in the project-based learning process. Efforts to provide experience and the ability to conduct simple research to students are positive things that can be obtained from project-based learning. However, there are obstacles to implementing project-based learning, one of which is the limited time that students and teachers have (Glackin, 2016). Based on the above opinion, it can be concluded that Project Based Learning (PjBL) is a learning model that makes students active learners who experience holistic learning to produce products from a given project based on a problem experienced directly by students. Problem Based Learning (PBL) or problem-based learning is a learning model that is carried out based on a problem to develop critical thinking, creativity, and systematic reasoning through problem-solving (Faqiroh, 2020). The main purpose of the PBL learning model is the skill or ability to see a problem, conduct investigations, analyze, provide solutions to these problems and implement; what is certain is that the main goal of PBL is not to solve a problem (Widodo, 2021).

▪ METHOD

This study uses a quasi-experimental method (Fraenkel, 2012). Quasi-experimental research aims to test the hypotheses made and provide a clear picture of a problem or object under study (Creswell, 2014). There were two groups involved in this experiment. The design of this study is shown in Table 1

Table. 1 Research design

Group	*Prettest*	*Treatment*	*Posttest*	*Delayed Posttest*
Experiment 1	O_1	X_1	O_1	O_2
Experiment 2	O_1	X_2	O_1	O_2

X1 : The treatment is in the form of implementing Experiential Learning by using the Project Based Learning (PjBL)
X2 : The treatment is in the form of implementing Experiential Learning by using the Problem Based Learning (PBL)
O1 : Filling Out Questions and Questionnaires on Climate Change
O2 : Solving Problems to test student retention on Climate Change

This research was conducted at SMP Negeri 8 Kupang. The samples of this study were 30 students in class VII G (control class) and 30 students in class VII H (experimental class). The instruments used in this research are questions to test the knowledge of students totaling 25 multiple choice questions about climate change; a questionnaire to find out beliefs consisting of 15 questions and concrete actions from students on climate change consisting of 13 questions. The research was carried out in February-March 2022 when learning was still being carried out online due to the COVID-19 pandemic. In this study, it was carried out in a blended manner, namely, the provision of subject matter was carried out online, while the project work given by the teacher to students was carried out on site. The learning method used in the experimental class uses the Project Based Learning (PjBL) learning model and the control class uses the Problem Based Learning (PBL) learning model.

Changes in learning outcomes from the results of the pre-test and post-test will show the level of students' knowledge of the material provided. If there is an increase, the students understand the material given by the teacher. Questionnaire for trust and desire to take real action using a Likert scale with 4 scales (Hill, 2018). For the confidence questionnaire, namely Very Confident, Confident, Not Confident, Very Uncertain. For a desire questionnaire to take concrete actions, namely Very Want, Want, Don't Want, and Really Don't Want. To see real action, students are asked to plant trees in their home yards and make a video containing an invitation to plant trees and protect the environment from global warming which is published on social media accounts owned by students. The results of publications on social media are informed to the teacher in the form of a screenshot of the post from the student.

▪ RESULT AND DISSCUSSION

Data from the research results of students' knowledge about climate change were statistically analyzed using SPSS version 22. The analysis was carried out for normality test, homogeneity test, and hypothesis testing. Based on the results of the SPSS test, the following research results were found. The average value of the pre-test of the control class and the experimental class has almost the same value; Pre-test data from both classes were normal and homogeneously distributed, so it can be concluded that the student's initial knowledge about climate change from the two classes was not significantly different. Students' initial knowledge about climate change does not differ significantly and has a low average score, this is because the issue of climate change has

not become a central issue discussed in public talks and also in learning, especially in basic education (Paliani, 2019). The lack of information and socialization from educators in basic education units causes little knowledge for students about what climate change is, the causes of climate change, and the impact of climate change on human life. The absence of learning about climate change is in line with the education curriculum in Indonesia where basic competencies on climate change have not been discussed in basic education, the issue of climate change is discussed at the Junior High School (SMP) education level in grade VII (Seven) and continues at the Level VII. Senior High School (SMA) in class X (Kemdikbud RI, 2018). The material on climate change is a new material for students at the junior high school level, namely in class VII. The issue of climate change is an important issue that should be socialized from an early age, namely to students at the basic education level.

Based on the N-Gain value, it can be seen that the PjBL learning model can increase students' knowledge about climate change. Increased knowledge of students can occur because the PjBL learning model has its advantages and characteristics that can be applied to materials on climate change and in blended learning, namely learning that is carried out online (In the Network) and Offline (Outside the Network). The material on climate change turns out to be suitable for using the PjBL learning model because one of the advantages of the PjBL learning model is that in the learning process, in addition to being able to explain knowledge about climate change to students, it also provides awareness, confidence and ultimately provides opportunities for students to take real action. in preventing global warming that is happening today through projects that have been carried out by students both individually and in groups (Seaman, 2013).

One of the characteristics of the PjBL learning model is that students are faced with a concrete problem that is experienced directly by students and then students and their group friends design a project which is a solution to the problem, where the solution designed in the project can be done by students (Kalafatis, 2019). The role of the PjBL learning model in increasing students' knowledge of climate change is evident from each stage of the learning activities carried out, namely from the problems experienced directly by students to the stage of implementing projects and products resulting from learning activities. The problems presented in the study on climate change are the occurrence of a tropical cyclone storm in the province of NTT in 2021 and the reduction of the coastline. These two problems, namely the seroja tropical cyclone and the reduction of the coastline are also experienced directly by students who live in the city of Kupang. The PjBL learning model can improve the critical thinking and creativity of students, where this critical thinking and creativity pattern is formed from the problems experienced directly by these students (Lou, 2017).

The critical thinking patterns of students began to be seen through various questions given by students, which were finally concluded into three questions that were discussed together in learning activities, namely (1) why did the tropical cyclone occur in the province of East Nusa Tenggara? (2) What are the consequences if the coastline experiences a reduction in coastline? and (3) What actions can be taken to prevent climate change from occurring? The creative mindset of students produces concrete actions (solutions) that are used to prevent global warming. The concrete actions (projects) that were carried out were planting trees in the home and schoolyards, as well

as taking pictures/videos of socialization about climate change that occurred in the environment where students lived and subsequently published on social media owned by students such as Facebook, Instagram, and TikTok.

Learning in the classroom using the PjBL model becomes an interesting, meaningful, and useful teaching and learning process when it involves competent external parties in the material presented to students (Sund, 2020). The Meteorology, Climatology, and Geophysics Agency (BMKG) was allowed to deliver material on climate change and tropical cyclones to provide an understanding and a new atmosphere for students in the learning process. The BMKG is considered to have a better understanding of the material about climate change and the impacts of climate change because the material is specifically studied by the BMKG. Submission of subject matter and material from BMKG is carried out online (On the Network) because it is still in the atmosphere of the COVID-19 pandemic. Online learning carried out during the Covid-19 pandemic only provides knowledge but does not provide direct experience to students.

To provide a direct experience of climate change to students, students are allowed to observe the coastline directly and in their respective groups that have been determined. In observation activities, discussions and group work are carried out offline (outside the network) but are limited to small groups where each group consists of three people to create effectiveness in learning activities. Students are given the opportunity in their respective groups to observe directly the coastal areas that are experiencing coastline reduction. All of the learning activities are carried out by hybrid learning, namely learning that is carried out online (in the network) and offline (outside the network). Students look very motivated to work together and do every task (project) given by the teacher. In learning in the PjBL class, students are allowed to explore and try to find solutions to existing problems to create fun learning (Paliani, 2019).

Learning in class with the PjBL learning model provides a new color, enthusiasm, and high motivation for students, this is evidenced by the active participation of students in doing observation tasks, working on given discussion tasks, and punctuality in collecting the assigned project assignments. The whole learning activity from start to finish using the PjBL learning model makes students observe, feel, and think until finally, students can take real action to prevent global warming (Bouhazzama, 2021). The schedule for observing the coastline, planting trees, and making socialization pictures or videos about climate change is carried out after the Teaching and Learning Activities (KBM). This schedule is made based on mutual agreement in a predetermined group. On this occasion, students learn to build good communication and cooperation with group friends in working on any given project. This is in line with research conducted by previous researchers, namely the PjBL learning model that enables students to build good communication and cooperation with their respective group mates (Sugiharto, 2020).

Students can present their observations about changes in coastlines, pictures, and videos containing invitations, appeals, and solutions to overcome global warming and the tree planting activities they do. Pictures and or videos of every activity that has been carried out in the learning process are then published on social media owned by each student. From this, it can be seen that implementing the PjBL learning model, raises the confidence of students and a sense of love for the environment. Implementing positive

activities in PjBL learning, these positive activities can increase the interest and motivation of students in studying material about climate change and its impact on human life (Tseng, 2013).

Based on the results of the questionnaire data analysis of students' beliefs on climate change using SPSS 22, it shows that students' beliefs about climate change before being given treatment are not significantly different. In the second indicator, 48.33% believe that climate change is the result of human actions. The students in the control class did not realize that some of the actions they took turned out to be a contributor to global warming. In the activity of observing the coastline directly and listening to the material presented directly by the Meteorology, Climatology, and Geophysics Agency, students become convinced that climate change is happening and is happening right now, as evidenced by the event of the Seroja tropical cyclone. The average increase in the confidence level of students in both the control class and the experimental class is 26%. With the PjBL learning model and the PBL learning model, it turns out that it can change the mindset and succeed in convincing students that global warming that is causing climate change is the contribution of human action. In the second indicator, it is clear that there is a significant difference in changes.

Learning becomes meaningful if students can provide real action or apply what has been learned. At the time of giving the pre-test, students answered real actions only in the form of normative answers that had been stored in their cognitive. More than some students stated in writing that they would take positive actions to protect the earth from global warming. During the learning activities, the PjBL class was given a project that started from observing the impacts of climate change to the actual actions that had been taken which were reported in the form of documentation. Actions taken are planting trees, editing videos taken from beach conditions that continue to experience a decrease in the coastline, and videos of tropical cyclone Saroja the edited videos are shared on social media, both Facebook and Instagram. With real actions taken by students in learning activities, they change their mindset about climate change. Based on the results of the post-test to measure the real actions of students on climate change, the results were significantly different from the previous pre-test.

▪ CONCLUSION

Climate change is a serious problem that must be socialized to students from an early age. When students know about climate change and its impact on human life from an early age, it will create awareness and real action to overcome this climate change. The world of education is the right institution to continue to socialize climate change. Educators must take this important role in every learning activity so that the material on climate change becomes interesting material and can be understood well by students. Learning based on experience (Experiential Learning) is one of the appropriate learning models, which can be used in learning, especially material on climate change, because this learning model in addition to providing knowledge to students, also teaches students to be aware and take real action. to prevent global warming.

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