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Implication of Problem-Based Scenarios on Students' ESD Anticipatory Competency on the Concept of Environmental Change

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ABSTRACT
This study aims to determine the effect of problem-based scenarios on students' ESD Anticipatory Competency on environmental change material. It is motivated by the difficulty of students when asked to respond to future events, and further research needs to be done on the right learning model to equip Anticipatory Competency. So, the learning model used in this study is Problem-Based Scenarios. The type of research used is quasi-experiment with Non-Equivalent Control Group Design. The research sample was selected using purposive sampling, class X IPA as an experimental class of 19 students and X IPS-2 as a control class with 18 students. The instruments used in this study were Anticipatory Competency questions consisting of 5 essay questions, and a questionnaire for students' responses to Problem-Based Scenarios consisting of 10 statements. The results of the study based on hypothesis testing obtained a significance value of Sig (2-tailed) of 0.000, then H^0 is rejected and H^1 is accepted. The results of the students' response questionnaire regarding the use of Problem-Based Scenarios showed an average score in the excellent category (81-100). The results of the instrument in this study indicate that problem-based scenarios affect the Anticipatory Competency of students on Environmental Change material.

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1. INTRODUCTION

More than 80% of the waste generated by human activities is discharged into rivers and oceans without any treatment, resulting in environmental pollution and more than 50 diseases, even 80% of diseases and 50% of child deaths worldwide are related to poor water quality (Lin et al., 2022). Various human activities directly affect water quality, including urbanization, population growth, industrial production, climate change, and other factors (Halder & Islam, 2015). According to UNESCO's World Water Development Report (2021), approximately 829,000 people die each year from diarrhea caused by unsafe drinking water, sanitation, and hand hygiene, including nearly 300,000 children under the age of five, which represents 5.3 percent of all deaths in this age group. In addition, UNESCO (2020) also added that changes in the water cycle will also pose risks to energy production, food security, human health, economic development and poverty alleviation, thus seriously jeopardizing the achievement of the Sustainable Development Goals. According to UNESCO (2012) sustainable development refers to many processes and pathways to achieve it (e.g. sustainable agriculture and forestry, sustainable production and consumption, good governance, research and technology transfer, education and training, etc.). All sustainable development programs should consider the three areas of sustainability - environment, society and economy - as well as the underlying cultural dimensions.

Given the environmental challenges facing the world in the 21st century and the role of education in changing individual attitudes, behaviours, and lifestyles through awareness, capacity building, and other means, a reorientation of education is needed to respond to these issues (Sarabhai, 2015). In sustainable development there are 17 goals with 169 measurable achievements called sustainable development goals (SDGs) (UNESCO, 2017). One of the efforts in realizing the SDGs is through education. Education can be described as a great hope to design a better sustainable future and is also one of the efforts in overcoming the environmental crisis (Wilujeng et al., 2019). Therefore, the emergence of Education for Sustainable Development (ESD) or Education for Sustainability (EfS) is needed to address these ongoing challenges. Overall, ESD standards aim to cover the

following areas: global citizenship, environmental awareness and management, futures thinking, social justice, and ethics and well-being; most of which are concepts included in the 17 SDGs (UNESCO, 2017).

The five core competencies of sustainable development or Sustainability Development Goals (SDGs) include systems thinking competency, Anticipatory Competency, normative competency, strategic competency, and interpersonal competency (Giangrande et al., 2019). However, UNESCO (2017) reduced the point of interpersonal competence and added four other key competencies, including collaboration competence, critical thinking competence, self-awareness competence, and integrated problem-solving competence. One part of the competencies in ESD is Anticipatory Competency, which includes the ability to analyze, evaluate, and imagine the future (Ojala, 2017).

Anticipatory Competency is defined as the ability to collectively analyze, evaluate and envision the future, relating to sustainability issues within a problem-solving framework (Wiek et al., 2011). Research shows that Anticipatory Competency is one of the top three competencies considered important in continuing education (Rieckmann, 2012). The concept of Anticipatory Competency is also aligned with one of the sub competencies of the term Gestaltungs competence or 'shaping competency' developed by de Haan (2006) which includes forward thinking. Through active participation, this competency enables people to not only imagine future worlds but also act to change and shape the future, directing social, economic, community and environmental change, in line with the SDGs (de Haan, 2010). Anticipatory Competency is closely related to the ability to predict. It was noted that 16 out of 26 high school students had a high category in predicting something in learning related to effort and energy (Rosa, 2017). On the other hand, the ability to predict in high school students for Ecosystem material is classified into the medium category (Nurroniah, 2017). In addition, the comparison of Anticipatory Competency of junior high school students in Indonesia, such as the ability to anticipate and predict something, is still unequal (Dewi & Khoirunisa, 2018; Rosa, 2017; Nurroniah., 2017).

The results of preliminary observations in one of the schools in the district of Sukabumi, it is known that Anticipatory Competency has not been provided to students in the biology learning process. On the other hand, this school has a strategic location because it is close to a tourist attraction in the area, namely Lake Sukarame. This lake has environmental problems, especially the behaviour of people who throw garbage into the lake. According to UNESCO, (2020), water-related ecosystems such as lakes, rivers, and vegetated wetlands are among the most biologically diverse environments in the world and provide many benefits and services to society, making them important for achieving several Sustainable Development Goals (SDGs). UNESCO (2020) also adds that water-related ecosystems have significant economic, cultural, aesthetic, recreational and educational values. They help maintain global hydrological, carbon and nutrient cycles and support water security, provide natural freshwater, regulate flow and extreme conditions, purify water and recharge aquifers. Other services also depend on these ecosystems, which provide water for drinking, agriculture, employment, energy generation, navigation, recreation and tourism (UNESCO, 2020). By providing real-world problems as a context for learners, it will train how to create scenarios, think anticipatively, and consider various future possibilities that will occur. Based on this, MA Syarikat Islam Parakansalak was chosen as a research site to train Anticipatory Competency to support sustainable development included in 17 SDGs, namely SDGs-6 "Clean Water and Sanitation".

Learners who have Anticipatory Competency can anticipate the continuity of a problem by designing scenarios, considering various things that can hinder an effort, connecting various solutions, identifying events that trigger a phenomenon, and compiling a vision and mission of the desired future from various alternatives. Learners are also able to solve future problems, including preventive action, mitigation, adaptation, and appropriate decision-making (Arizona State University, 2016). Given these reasons, Problem Based Scenarios is believed to be one of the learning models that can be applied to biology learning, especially if the topic raised is a complex real change. This is based on research that proves that problem-based scenarios arouse teachers' curiosity and ability to predict (Sezgin Selcuk, 2015). Another study showed that problem-based scenarios with experiments contributed to biology self-efficacy and critical thinking tendencies of prospective science teachers (Huriye, 2021).

Most of the current literature on scenario-based learning has identified four main types of learning scenarios, which can be listed as follows; (Gonda et al., 2015; Paige & Lloyd, 2016; Roberts, 2011): 1) Skills-based scenarios: learners are asked to demonstrate their knowledge in a practical way by producing or performing a set of procedures; 2) Issue-based scenarios: learners are asked to explore, debate, discuss, and negotiate a range of issues around real-world problems; 3) Speculative-based scenarios: learners are allowed to consider a range of past, current, or future events; 4) Problem-based scenarios: learners are asked to find alternatives, examine possibilities, evaluate consequences to arrive at a solution. A scenario can be defined as a description of a possible future situation (Kosow & Gaßner, 2008). Problem-Based Scenarios can help individuals to understand how to become specialized, take advantage of their own and others' lives, and make reasoning and learning explicit (Schank, 2002). According to Kosow & Gaßner (2008) scenarios differ from other approaches to future assessment, such as forecasting and risk assessment, in that they explicitly consider various possible futures. In addition, scenario learning can enhance deep learning by involving learners in realistic incidents, where they are forced to consider various factors, make decisions, and reflect on the results of what they have learned (Al-attar,

2019). According to Ireland et al., (2013) scenario-based learning uses the act of creating scenarios as a teaching-learning mechanism that resembles actual situations. In other words, through Problem-Based Scenarios, learners can be in a series of circumstances as an outline of events that simulate real-world practices, providing opportunities that may be difficult for learners.

Based on the explanation above, the purpose of this study is to determine the effect of using Problem-Based Scenarios on Anticipatory Competency Education for Sustainable Development (ESD) of high school students on Environmental Change material.

2. RESEARCH METHOD

This research uses a type of quasi-experimental research or pseudo-experiment. This method is done by looking for information about existing symptoms so that it can determine the objectives to be achieved. The quasi-experimental method is the provision of treatment by measuring what is the result of a treatment that is not randomly selected. This research has a control class but does not function fully because there are external variables that cannot be controlled by the researcher. This study aims to determine the effect of certain treatments on other treatments under controlled conditions (Sugiyono, 2017).

The research design used in this study was Non-equivalent Control Group Design, where the experimental class and control class were not randomly selected. At the beginning of learning, both classes were given an initial test (pretest) with the same test format. Then the experimental class was given treatment in the form of applying Problem-Based Scenarios in the learning process, while the control class was treated with a learning model that is often used in the learning process, namely Problem-Based Learning. After being treated, both classes were given a final test (posttest), then the results of the two tests in each class were compared. This research was conducted at MA Syarikat Islam Parakansalak which is located at Jalan Raya Parakansalak No.23, Parakansalak District, Sukabumi Regency. The implementation time of this research was conducted in May 2023 for two weeks. The object of the research was students in grades X IPA and X IPS MA Syarikat Islam Parakansalak in the 2022/2023 academic year who were in the even semester. In this study, the samples selected were two classes, namely X MIPA and X IPS 2 classes selected using purposive sampling technique, the experimental class numbered 19 students, and the control class numbered 18 students. Data collection is done by giving tests and giving questionnaires, so that the research instruments used as tools in data collection in this study are two consisting of 1) student Anticipatory Competency questions consisting of 5 description questions used to measure student Anticipatory Competency; 2) student response questionnaire to the application of Problem-Based Scenarios in Anticipatory Competency debriefing consists of 10 statements (positive statements consist of six statements and negative statements consist of four statements). The Anticipatory Competency research instrument used to collect data was first tested for validation by expert validators. Furthermore, an external trial was carried out at a different class level, namely class XI IPA who had received Environmental Change material. Researchers made 10 items of Anticipatory Competency questions in the form of description questions. The results of the trial were then analyzed using the Anates application and obtained data on validity, reliability, difficulty level, and question discrimination. Based on the results of the trial, it is known that the Anticipatory Competency questions prepared by researchers can be used in collecting research data.

Then the data analysis of the research results was carried out statistically on the instrument of the Anticipatory Competency pretest and posttest questions and the students' response questionnaire using the SPSS and Microsoft Excel applications. Data processing of pretest and posttest scores includes parametric analysis prerequisite tests (normality and homogeneity tests), and hypothesis testing which is analyzed using an independent t test. The data analysis technique of the learner response questionnaire was analyzed using a Likert scale with five alternative answers, namely strongly agree, agree, neutral, disagree, and strongly disagree.

3. RESULT AND DISCUSSION

The data obtained in this study are data collected from the Anticipatory Competency test in the form of pretests and posttests given to experimental and control classes, student response questionnaires in experimental classes, and the results of interviews with Biology subject teachers who teach in both classes. The treatment given to the learning of Environmental Change material in the experimental class (X IPA) uses Problem-Based Scenarios, while the control class is given treatment using the Problem Based Learning learning model. Pretest was given before learning (before treatment) which aims to determine the extent of the initial ability of students in experimental and control classes. While the posttest is given after the learning process is carried out to determine the extent of students' Anticipatory Competency after being given treatment and also to determine the effect of Problem-Based Scenarios on students' Anticipatory Competency in the experimental class. Based on the data collected, a description of the data that has been obtained will be explained.

Implication of Problem-Based Scenarios on the Anticipatory Competency of ESD Learners on Environmental Change Material

The description questions are made to measure the extent of students' Anticipatory Competency on Environmental Change material based on UNESCO (2017) Anticipatory Competency indicators, which include: 1) evaluate various possibilities; 2) determine a vision of the future; 3) apply the precautionary principle; 4) assess the consequences of an action; and 5) face risks and changes. The description questions consisted of 5 items and were loaded based on these indicators. The pretest and posttest results of the experimental and control classes were subjected to a parametric analysis prerequisite test of the pretest and posttest values of the experimental and control classes which included normality and homogeneity tests. To find out whether the data is normally distributed or not, a normality test is carried out. After knowing the data is normally distributed, a homogeneity test is carried out to determine whether the data varies homogeneously or not. After obtaining normally distributed data and homogeneous variance, the prerequisite analysis test has been fulfilled, then the parametric hypothesis test can be carried out, namely the Independent Sample t-test. The data used in hypothesis testing in this study used posttest results in experimental and control classes. This parametric analysis prerequisite test and hypothesis test were analyzed using SPSS 29. The recapitulation of the analysis results is presented in Table 1 below.

Table 1. Recapitulation of Normality, Homogeneity, and Hypothesis Tests

Tests	Class	Description	Score (Sig.)	Description
Normality Test (*Shapiro-Wilk*)	Experiment	*Pretest*	0,058	Normally distributed data
		Posttest	0,413	
	Control	*Pretest*	0,174	
		posttest	0,373	
Homogeneity Test	Experiment and Control	*Based on Mean*	0,611	Homogeneously distributed data
		Based on Median	0,581	
		Based on Median and	0,582	
		with adjusted df		
		Based on trimmed mean	0,581	
Hypothesis Test (*Independen Contoh Uji-T*)	Experiment	*Pretest* (Sig (2-tailed))	0,089	Not significantly different
	Control	*Pretest* (Sig (2-tailed))	0,088	
	Experiment	*Posttest* (Sig (2-tailed))	0,000	Significantly different
	Control	*Posttest* (Sig (2-tailed))	0,000	

The results of the research on the normality test show that both classes, namely the experimental class and the control class, have a significance value of more than 0.05 (sig> 0.05) which means that the data in both classes are normally distributed. After knowing that the data is normally distributed in both classes, then the homogeneity test is carried out. The homogeneity test results based on Table 1 above show a value of 0.611> 0.05 which means that the data is homogeneously distributed because the resulting significance value is greater than 0.05. After obtaining data that is Normal and homogeneous distribution, then the post-test hypothesis test was carried out with the independent sample t-test test. To determine whether there is a difference in the initial ability of students in the control and experimental classes. Then a hypothesis test was carried out using SPSS on the pretest scores in the control class and experimental class. From the calculation of the independent sample t-test test on pretest data in the control class and experimental class, the sig. (2-tailed) of 0.089> 0.05 therefore the hypothesis H^0 is accepted and H^1 is rejected, that there is no significant difference in the pretest scores of the control class and the experimental class. This means that the two classes, namely the control and experimental classes, have the same initial ability. Because both classes have the same initial ability, then for decision making the results of the study were tested from the posttest data in the control class and the experimental class, and obtained a significance value of Sig (2-tailed) 0.000 which indicates that the post-test data in the experimental class and the control class are significantly different because the significance value is less than 0.05 (0.000 <0.05) so that it can be known that the hypothesis H^0 is rejected and H^1 is accepted. Therefore, it can be concluded that there is a significant effect of using Problem-Based Scenarios on students' ESD Anticipatory Competency on Environmental Change material.

The results of data processing above show that learning with Problem-Based Scenarios in the experimental class affects students' ESD Anticipatory Competency. This is because Problem-Based Scenarios can train students' Anticipatory Competency in forming opinions about the future, analyzing and describing future possibilities, developing foresight, and finding solutions to problems where in this study students are trained to find solutions based on real events or events given in the Learner Worksheet (LKPD).

In the experimental class there are two Learner Worksheets (LKPD), the first is about one of the environmental changes, namely water pollution, where students are given a scenario about water pollution before learning, then analyze and describe the possibilities that will occur in the future. After that, pouring the solution to the problem, finally students try to explain the problem situation in the scenario with a simple experiment about "Water pollution on the effect of fish survival". In the second Learner Worksheet (LKPD), students are given a scenario of water quality and safety. Just like LKPD-1, in LKPD-2 learners are also asked to analyze and describe the future possibilities that will occur. After that, pouring the solution to the problem, finally learners try to explain the problem situation in the scenario with a simple experiment on "Water Quality and Safety". That way learners are required to be able to determine the steps of observation that will be carried out to be able to draw conclusions from the observations that have been made. Thus, learners are trained to find new ideas and develop them independently. After conducting simple experiments on LKPD-2, students make posters about water quality and safety, then distribute them to the surrounding environment, especially the community around Lake Sukarame and upload these activities on social media. This is done to implement the Sustainable Development Goals (SDGs), namely SDGs-6 "Clean Water and Sanitation", and is included in the behavioral learning objective of participating in activities to improve water management and sanitation in the local community (UNESCO, 2017).

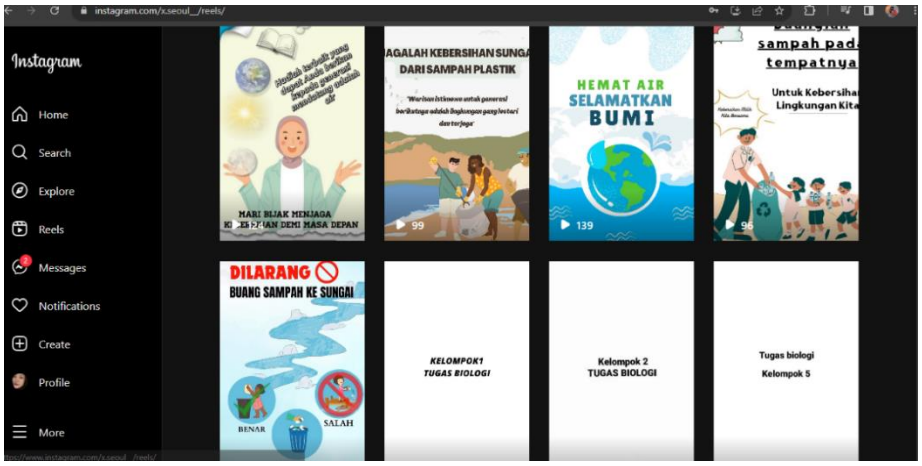

Figure 1. Improved "Water and Sanitation" Management Activities uploaded on social media

Problem-Based Scenarios can accommodate learners' Anticipatory Competency in identifying events that trigger a phenomenon, considering various things, connecting various solutions, and compiling the desired future vision and mission from various alternatives. This is in line with research that proves that the use of Problem-Based Scenarios has a major effect on skill development (Abdullah, 2018). Scenarios have been used in various domains (e.g. marketing, software development, medicine, game development, economics, and others) as a structuring resource to plan for the future, thus anticipating situations and generating possible solutions to identified future problems (Pedro et al., 2019). The use of learning scenarios in education can be a way to promote the development of 21st century skills, namely those related to problem solving, communication, critical thinking, and creativity (Matos, 2014). Similarly, Al-attar, n.d. (2019) points out that scenario-based learning strategy is a methodology that aims to promote deep learning and awareness by engaging learners in realistic critical incidents where they are also forced to consider various factors, make decisions, and reflect on the outcomes and what they have learned.

Carroll (1999) points out five reasons for adopting scenario-based design in the design of new technology applications: scenarios are thought-provoking; scenarios are concrete and flexible; scenarios generate multiple views of interaction; scenarios can also be abstracted and categorized; and scenarios encourage work-oriented communication. Based on these reasons, Matos (2014) points out a series of scenario structuring elements: organizational environment design; roles and actors; storylines, strategies, actions, and activities; and reflection and regulation. Clark (2009) also states that Problem-Based Scenarios incorporate learning spaces, including a) communication spaces, where learners communicate information in both verbal and nonverbal forms; b) simulation spaces, where simulations and re-enactments take place; c) experience spaces, where learners learn by doing, observing the results, and reflecting on their learning. Based on this, the researcher argues that Problem-Based Scenarios are very important to be included in the learning process because they can train students' Anticipatory Competency, where students can identify and analyze future possibilities and solve problems in future problems. This is what makes the Anticipatory Competency of students in the experimental class superior to the control class.

Occurrence of Learners' ESD Anticipatory Competency on Each Indicator

To determine the ESD anticipatory competency, the N-Gain test was conducted on the anticipatory competency of students on each indicator, analyzed after obtaining the pretest and posttest results in the experimental class and control class, then the N-Gain test was conducted to determine the difference between the posttest and pretest scores to determine the anticipatory competency of students which showed the effect of learning in the experimental class after learning by the teacher. The N-Gain test in this study was calculated using the Normal-Gain Test equation according to Meltzer (2002):

$$N - Gain = \frac{Score\ posttest - Score\ pretest}{Score\ ideal - Score\ pretest}$$

After the calculation, the normalized gain criteria were made according to Hake modified by Sundayana (2018). An overview of the N-Gain score criteria can be seen as follows:

Table 2. N-Gain Score Criteria

N-Gain Range	Criteria
0.70 ≤ g ≤ 1.00	High
0.30 ≤ g < 0.70	Medium
0.00 < g < 0.30	Low
G = 0.00	No increase
-1.00 - ≤ g < 0.00	Drop

(Sundayana, 2018)

The results of the N-Gain test on pretest and posttest scores can be seen in Table 3. below.

Table 3. Recapitulation of Learners' Anticipatory Competency on Each Indicator

NO.	Anticipatory Competency Indicator (UNESCO, 2017)	Experiment Class Average Score			Control Class Average Score		
		Pretest	***Posttest***	***N-Gain***	***Pretest***	***Posttest***	***N-Gain***
1.	Evaluate the possibilities.	1.5	3.4	0,77	1.5	2.5	0,40
2.	Assessing the consequences of an action.	1.5	3.1	0,63	1.4	2.2	0,32
3.	Define a vision for the future.	1.4	3.4	0,76	1.1	2.5	0,49
4.	Dealing with risk and change.	1.4	3.0	0,62	1.3	2.4	0,42
5.	Apply the precautionary principle.	1.4	3.4	0,76	1.0	2.2	0,41
	Average	1.44	3.26	0,70	1.26	2.36	0,40

Based on Table 3 above, it can be seen that the average pretest and posttest scores in the experimental and control classes show an increase in each indicator. The average pretest and posttest scores in both classes increased where the average pretest and posttest scores of the experimental class were higher than the control class so that the N-Gain score of the experimental class was superior to the control class. To clarify the data analysis above, it is presented in diagram form in Figure 2 below.

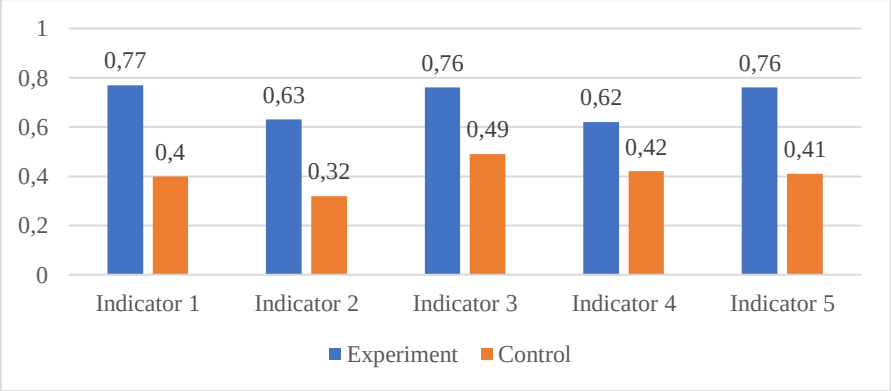

Figure 2. Comparison Diagram of N-Gain Score Anticipatory Competency of Learners on Each Indicator

Based on Table 3 and Figure 2 above, it can be seen that the N-Gain score on each indicator in the experimental class is superior to the control class. This shows that the students' ESD Anticipatory Competency in the experimental class is superior to the control class.

Based on Figure 2 above, it can be seen that the Anticipatory Competency of experimental class students shows good criteria with N-Gain scores at high and medium criteria. This is because in the experimental class researchers used Problem-Based Scenarios, taking steps to prepare scenarios based on real stories, then students read and understand the contents of the scenario, then identify problems and analyze them with group discussions about the LKPD that has been provided. Furthermore, students look for solutions to these problems. Finally, learners design and carry out experiments by explaining the problem situation in the scenario with experiments, and evaluate the learning process together. Then to realize the goal of sustainable development, namely SDGs-6 (Clean Water and Sanitation), researchers give project assignments to students by making posters about improving water quality and safety, and distributing them to the environment and local communities, whose purpose is about behavioural learning objectives, namely learners can plan, implement, evaluate and replicate activities that contribute to improving water quality and safety (UNESCO, 2017). Thus, Problem-Based Scenarios are particularly useful and effective because they are problem-centered, and draw on the learner's experience, thus encouraging processing and verbalization of thought.

Based on Table 3 and Figure 2 above, it can be seen that there are differences in N-Gain scores on each Anticipatory Competency indicator in both experimental and control classes. This is because each student has a different pattern of understanding so that there are differences in each indicator. The first indicator, namely the assessment of various possibilities, consists of one sub-indicator on the Anticipatory Competency test, namely analyzing phenomena based on data on environmental changes. The average N-Gain score in the experimental class was 0.77 with a high category while in the control class the average N-Gain score was 0.40 with a medium category. This shows that students in the experimental class have been able to evaluate various possibilities very well which is also evident from the average posttest score of experimental class students of 3.40 which shows that in general students have mastered these indicators.

The high ability of students in the experimental class on this indicator is due to the learning process by applying Problem-Based Scenarios which asks students to consider various factors regarding future possibilities, then students try to explain the problem situation in the scenario with simple experiments. This is through a response questionnaire regarding student responses to the use of Problem-Based Scenarios on Environmental Change material obtained an average score of 84.7 (very good). These results show that by using Problem-Based Scenarios on Environmental Change material, students better understand the material in the learning process. This is in line with the acquisition of post-test scores and the average N-Gain of the experimental class is superior to the control class.

Whereas in the control class, students are used to what the teacher gives, so the exploration process is less well developed. This is in line with the opinion of Al-attar, (2019) showing that the scenario-based learning strategy is a methodology that aims to increase deep learning and students are also forced to consider various factors.

The second indicator is assessing the consequences of an action. This 2nd indicator consists of one sub-indicator on the Anticipatory Competency test, namely analyzing the causes, impacts, and efforts to overcome environmental changes. The average N-Gain score in the experimental class was 0.63 with a medium category, and in the control class the average N-Gain score obtained on this indicator was 0.32 with a medium category as well. The difference in the average N-Gain score results in the experimental and control classes is due to the use of Problem-Based Scenarios in the experimental class emphasizing students to explore more in assessing the consequences of an action so that students can analyze the causes, impacts, and efforts to the problems given. Matos (2014) defines learning scenarios as "hypothetical teaching-learning situations (purely imaginary or with real substance, extensively changeable) consisting of a series of elements that (i) describe the context in which learning takes place, and (ii) structure the environment in which learning occurs".

The third indicator is determining a vision for the future which is divided into one indicator, namely understanding water as a basic condition of life itself, the importance of water quality and quantity, and the causes and consequences of water pollution and scarcity. In this indicator, the average N-Gain score in the experimental class was 0.76 with a high category, while the control class obtained an N-Gain score of 0.49 with a medium category. Based on these results, it shows that experimental class students excel in understanding the importance of water quality and quantity. In addition, students can also determine a vision for the future so that water quality and quantity are maintained. This is based on the response questionnaire regarding student interest in Problem-Based Scenarios on Environmental Change material with an average score of 81.8 (very good). These results show that by using Problem-Based Scenarios on Environmental Change material, students are encouraged to find new ideas and are very interested in learning about Environmental Change material. This is due to the influence of Problem-Based Scenarios applied to the experimental class. Paige & Lloyd (2016), mentioned that scenarios can provide opportunities to think about how we want this world in the future to be better in an achievable way.

The fourth indicator faces risks and changes consisting of one sub-indicator, namely analyzing the causes, impacts, and efforts to overcome environmental changes. The average N-Gain score obtained by the experimental class on this indicator was 0.62 with a medium category, and the average N-Gain score obtained by the control class was 0.42 with a medium category. The difference in the average N-Gain score in the experimental and control classes is due to the use of Problem-Based Scenarios in the experimental class emphasizing students to analyze and develop a deeper understanding of the topics discussed so that students can analyze the causes, impacts, and efforts to the problems given. This is through a response questionnaire regarding the clarity and ease of learning Problem-Based Scenarios on Environmental Change material with a score obtained of 75.3 (good). These results indicate that with the use of Problem-Based Scenarios on Environmental Change material, students can provide a simple explanation of environmental change. Tetchueng et al., (2008) argue that learning scenarios describe learning activities to acquire domain knowledge and knowledge to solve specific problems. Therefore, the right learning approach is needed to teach it such as Problem-Based Scenarios conducted in the experimental class showed good results.

The fifth indicator is applying the precautionary principle. In this indicator, the Anticipatory Competency test asks students to be able to create ideas/solutions to solve environmental change problems. The average N-Gain score obtained by the experimental class on this indicator was 0.76 with a high category and the average N-Gain score obtained by the control class was 0.41 with a medium category. Based on these results, it shows that students in the experimental class are superior in making ideas/solutions to solve environmental change problems. This is due to the influence of Problem-Based Scenarios applied to the experimental class. In line with this, student responses to the relationship between Problem-Based Scenarios and Anticipatory Competency also showed very good results with the highest average value compared to other response questionnaire grids, namely 86.0 (very good). These results indicate that the use of Problem-Based Scenarios makes it easier for students to have Anticipatory Competency. This is in line with Paige & Lloyd's research (2016) Problem-Based Scenarios can help learners to develop future thinking, help learners understand the various possibilities that will be faced and choose and create the desired future, and learners learn to build knowledge by using existing knowledge.

4. CONCLUSION

Based on the results of the research and data analysis, the conclusion of the hypothesis test results obtained from the calculation of posttest values obtained a significance value of 0.000 which indicates the effect of Problem-Based Scenarios on Anticipatory Competency of high school students on Environmental Change material. The emergence of ESD Anticipatory Competency in each indicator in the experimental class is generally in the high category except for the 2nd and 4th indicators which are in the medium category. Student responses regarding the application of Problem-Based Scenarios obtained scores ranging from 81-100 so that they were included in the very good category. All instruments used show the results that there is an effect of using Problem-Based Scenarios on ESD Anticipatory Competency of high school students on Environmental Change material.

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