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Integrating a blended discovery learning model with a bioenial website to empower science process skills and scientific attitude

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ABSTRACT

This study aims to determine; 1) the effect of integrating blended discovery learning with a bioenial website to empower Science Process Skills (SPS) of grade X students on the material of environmental change and preservation and 2) the effect of integrating blended discovery learning with a bioenial website to empower the scientific attitude of grade X students on the material of environmental change. The research method used a quasi experiment with a quantitative approach. The research design used posttest only control group design to measure SPS and pretest-posttest nonequivalent control group design to measure scientific attitudes. The population in this study were X grade students of SMA Negeri A Sukoharjo in the 2022/2023 academic year. The samples of this study were X2 class as experimental class 1 as many as 36 students, X4 as experimental class 2 as many as 36 students, and X5 as control class as many as 36 students. The sampling technique used was cluster random sampling. Data collection questionnaire (scientific attitude), observation (SPS, scientific attitude, syntax implementation), and documentation. Data analysis technique used ANOVA hypothesis test for SPS and ANCOVA for scientific attitude. The ANOVA test results showed the effect of integrating blended discovery learning with the bioenial website to empower SPS. The results of further testing with LSD show that Blended Discovery Learning is a treatment that is significantly different among the three class groups. The ANCOVA test results show that there is no effect of integrating blended discovery learning with the bioenial website to empower scientific attitudes.

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INTRODUCTION

Biology and the nature of science cannot be separated in science education because there is a development of thinking skills (mind on), science process skills (hand on), and scientific attitudes (heart on) so that in the implementation of learning teachers must emphasize more on the process so that science lessons become interesting for students (Wiryanti et al., 2014). Students will actively build their knowledge through various learning activities. In this regard, biological science offers various learning opportunities to understand scientific ideas and procedures. Students must engage in learning activities that foster process skills if they are to understand science as a whole (Roheni et al., 2020). The hallmarks of science learning are scientific methods, scientific attitudes, and scientific knowledge products (Sudarisman, 2015; Yunita et al., 2019).

According to Sudarisman (2015), biology learning should be focused on developing an active, critical, analytical, and creative problem-solving environment. Based on this perspective, it is in line with the Ministry of Education and Culture's program in the independent curriculum, namely launching a driving school program with the aim of realizing the Pancasila Student Profile, or students who have faith in God and have noble character, are independent, think critically, creatively, cooperate, and have global diversity (Kahfi, 2022). In addition, Permendikbud Number 16 of 2022 also explains that the learning process, especially biology, is carried out interactively, inspiring, fun, challenging, motivating students to be active, and providing space for independent creativity according to the interests and talents as well as the physical and psychological development of students.

A science process-oriented learning approach involving intellectual, manual, and social skills is science process skills (SPS) (Sudarisman, 2015). SPS includes various abilities, including the ability to observe, interpret, classify, predict, and so on (Tyas et al., 2020). SPS is very important for students to be able to train to be honest, thorough, and able to process the information they get (Novitasari et al., 2017). Most of the topics taught in biology emphasize activity-centered learning. Therefore, learners must engage in hands-on activities during biology lessons to develop appropriate process skills (Nworgu & Otum, 2013). However, the reality found in schools is that students' SPS is still low. The results of observations at SMA Negeri A Sukoharjo show that learning activities in the classroom are sometimes still teacher-centered and use textbooks as teaching materials so that it is not enough to empower students' science process skills. According to Novitasari et al. (2017), the low SPS of students is caused by the learning process that is carried out only centered on the teacher.

In biology learning, SPS is related to scientific attitudes because scientific attitudes must be possessed by someone who carries out the scientific process (Guswita et al., 2018). According to Kurniawati (2021), scientific attitude components are fostered in SPS-based learning, including responsibility, curiosity, honesty, openness, objectivity, creativity, and so on related to scientific attitudes. Effective science education involves developing process skills and scientific attitudes so that students can develop the habit of using scientific research when learning about new scientific ideas and products. To develop scientific findings that benefit life, scientific performance and scientific mindset must be utilized (Puti & Jumadi, 2015).

The important thing in creating 21st century skills is a scientific attitude that contains character education values that can maximize students to be better in participating in the learning process in class (Rampean et al., 2021). Scientific attitudes are attitudes that will emerge after carrying out the scientific process. Scientific attitudes can be interpreted as attitudes like a scientist such as honesty, thoroughness, objectivity, and so on (Sudarisman, 2015). Scientific attitudes are important in learning activities that are obtained through the process (Asmarani et al., 2017). The importance of scientific attitudes to be trained to students in the learning process because it can determine the success and effectiveness of science (Amintarti et al., 2018). Scientific attitudes are also needed by students in learning because they can provide motivation in their learning activities (Suryani & Sudargo, 2016). However, based on observations at SMA Negeri A Sukoharjo, the scientific attitude of students is still low. This is because learning is sometimes still teacher-centered so that students are less active and scientific attitudes are less developed. Students' scientific attitudes are less formed due to fixation on textbooks during the learning process rather than the actual learning process (Asmarani et al., 2017). Low scientific attitudes are caused by learning activities that are still conventional (Negoro et al., 2019). In addition, the low scientific attitudes of students can be seen from their conditions in class,

such as minimal curiosity, less active cooperation in groups, and copying friends' answers when doing assignments.

The discovery learning model can be an alternative to develop students' SPS and scientific attitudes. This is because the discovery learning model was created so that teachers do not directly provide subject matter but provide opportunities for students to find concepts by identifying deficiencies in learning materials (Wedekaningsih, et al., 2019 in Nurhamidah et al., 2022). On the other hand, integrating blended discovery learning provides opportunities for students to learn outside the classroom so that students can increase their scientific insights because the learning media is carried out online by utilizing existing technology and information. Although the situation has normalized after the Covid-19 pandemic, blended learning-based learning can still be implemented with some online and offline learning adapted to the current situation (Amanto & Khasanah, 2021).

Learning media is something that is needed in the learning process (Abriyanto et al., 2022). The use of e-learning-based learning media in the form of websites can help visualize learning materials and learning becomes student oriented (Palennari et al., 2018). The Bioenial website is one of the learning websites that can be accessed by teachers and students when carrying out learning activities in the classroom or outside the classroom. Bioenial website is not only equipped with complete features, but this website also has the potential that can be used to help empower SPS and students' scientific attitudes. Empowering students' SPS and scientific attitudes can be empowered through learning experiences in the form of practicum, presentation or making products. After that, the learning experience can be uploaded to the bioenial website page in the form of videos, images, photos, and descriptions which can later be known indicators of SPS and scientific attitudes. According to Sadikin et al. (2020), when learning materials are integrated into the website, students can access them anytime and anywhere, making it easier for them to learn. This is because websites do not require physical books to be brought to class, which can be utilized to solve some common problems related to learning in schools.

Based on observations made at SMA Negeri A Sukoharjo between September and November 2022, it is discovered that the school has used information technology to support the learning process. it is found that the school has utilized information technology to support the learning process. Each class at SMA Negeri A Sukoharjo is equipped with a projector that is used for learning activities such as displaying presentation slides and playing videos. Almost all students also have devices to support the learning process in class. Although learning has utilized existing technology, there is still no alternative to blended learning using a website. Blended learning requires teachers to guarantee that students have the fundamental knowledge and abilities required to access content via the online course component (Tsai & Tang, 2017).

Rosdiana & Taopik (2022), stated that through the discovery learning model in learning that involves the environment as a learning object can provide real and direct experience to students. Teachers can utilize the environment around the school as one of the fun learning resources so that environmental learning at school can attract attention and not be boring. The environmental change material was raised because it contains a number of real case studies that are directly related to the topics discussed in class and are used as learning tools and conversation starters (Puspitadewi et al., 2014). Environmental change materials are considered effective for developing SPS and scientific attitudes when taught using a series of student inquiry activities such as direct observation of environmental problems. It can be believed that studying environmental change subjects can provide direct personal experience to students by utilizing a scientific approach through observation, experimentation, or other scientific abilities to obtain accurate information (Izza et al., 2016).

The results of Abriyanto et al., research (2022), stated that the web-based Blended Learning LKS on environmental pollution material used in the learning process could improve students' SPS. In Patrianingsih et al., (2017)stated that the scientific attitudes of students whose learning used the discovery learning model were in the very good category. Another study stated that the SPS and scientific attitudes of students treated with the discovery learning model assisted by crossword media were better than the group of students treated using the Numbered Head Together learning model (Safitri et al., 2022). From these various studies, what distinguishes this research (novelty) is the integration of the blended discovery learning model with the bioennial website for empowering science process skills and scientific attitudes of students on environmental change material. This study aims to; 1) Know the effect of integrating the blended discovery learning model with the bioennial

website on students' science process skills on environmental change material; 2) Know the effect of integrating the blended discovery learning model with the bioennial website on students' scientific attitudes on environmental change material.

METHODS

Research Design

This study used quantitative research with quasi experimental research method (Rukminingsih et al., 2020). The research design used was posttest only control group design for SPS and pretest-posttest non equivalent control group design for scientific attitude. This study used two research designs due to differences in the form of data collection. For KPS data, data collection is in the form of observation so that it cannot see the initial data while for scientific attitudes in the form of a questionnaire, a pretest postest is made so that there is a comparison. The independent variable in this study is a blended discovery learning model with a bioenial website. The dependent variable in this study is the science process skills and scientific attitudes of students in classes X2, X4, and X5 of SMA Negeri A Sukoharjo in the 2022/2023 academic year. While the control variables in this study are learning materials and learning time allocation. This study was divided into two experimental classes and one control class. The experimental class consists of an experimental class using a blended discovery learning model with a bioenial website and a discovery learning model while the control class uses conventional learning. The experimental and control classes will conduct a posttest to measure students' science process skills and a pretest-posttest to measure scientific attitudes.

Population and Samples

The population in this study were grade X students at SMA Negeri A Sukoharjo in the 2022/2023 academic year, namely classes X1-X7, totaling 251 students. The samples taken in this study were X2 class students as class E1 using the Blended Discovery Learning model with the Bioenial Website as many as 36 students, X4 as class E2 using the Discovery Learning model without the Bioenial Website as many as 36 students, and X5 as class K using the Problem Based Learning model without the Bioenial Website as many as 36 students. The sampling technique used in this study was cluster random sampling. The sample selection was carried out by testing class equality using the ANOVA (Analysis of Variance) test with the help of the SPSS version 25 program which had previously carried out prerequisite tests in the form of normality tests and homogeneity tests. Class groups that have met the prerequisite test meet the prerequisite test followed by ANOVA test to determine the equality between classes. H0 states that the samples do not have the same average, while H1 states that the samples have the same average. ANOVA test decision if the sig. data value> $\alpha = 0.05$ then H0 is accepted. The selected classes are X2, X4, and X5.

Instrument

The data collection techniques used in this research are questionnaires, observation, and documentation. Questionnaires are used to measure the effect of integrating the blended discovery learning model with the bioenial website on students' scientific attitudes on environmental change material by asking several questions that must be answered by respondents. The data obtained is in the form of scores from the respondents. Scoring with a Likert scale. Measurements are arranged in the form of statements with the choice of Strongly Agree, Agree, Disagree, and Disagree. The statements in this questionnaire consist of positive and negative statements (Suryani & Sudargo, 2016). Observation was used to measure students' SPS and scientific attitudes. In addition, observations were also made to evaluate the implementation of the steps of the applied learning model, namely the blended discovery learning model. The implementation of the syntax of the learning model was measured using an observation sheet conducted by the observer using a checklist (√) on the sheet provided. Documentation was taken in the form of photos during data collection, such as the learning process, learning instruments, and cognitive scores obtained by students.

The instruments used in this study were observation of science process skills and scientific attitudes, scientific attitude questionnaire, and learning modules (Mulyatiningsing, 2011). The absolute requirement to get valid research results is that the instruments used are valid and reliable. The use of valid and reliable instruments in data collection is expected that the research results will be valid and reliable. The construct validity test is carried out by asking for opinions from experts

(judgment experts). Based on testing using summary statistics on Winstep to get an idea of how much reliability the student scientific attitude instrument has, the student scientific attitude instrument has 32 valid questions and 8 invalid questions. The Cronbach's Alpha value, which measures the interaction between person and item, is included in a very good level, namely 0.89 because it is above 0.8. After the instrument is constructed using the aspects to be measured based on certain theories, then the instrument is consulted with experts. Technically testing content validity can be assisted by an instrument grid. Construct and content validation was carried out by expert lecturers who were UNS biology education lecturers in the field of biology expertise. and the instrument was declared fit for use. The validity of the items used in this study can be seen using the RASCH model with the Winstep program. The question items are declared valid or function normally if the measurement meets the criteria presented in Table 1.

Table 1. Question Item Suitability Criteria Score

Criteria	Score
Outfit Mean Square (MNSQ)	0,5 < MNSQ < 1,5
Outfit Z-Standard (ZSTD)	-2,0 < ZSTD <+2,0
Point Measure Correlation (Pt Mean Corr)	0,4 < Pt Measure Corr < 0,85

Source: (Sumintono & Widhiarso, 2015 in Muntazhimah et al., 2020).

Reliability test is used to determine the consistency of measurement based on several times the implementation of measurements on the same group of subjects and obtained relatively stable results. The reliability test of the questionnaire instrument uses the RASCH model which is designated by the individual separation value (pearson separation) with instrument reliability using the reliability coefficient from the results of data analysis using the RASCH model with Winsteps software and Cronbach's Alpha coefficient. The following is the interpretation of the reliability test based on Cronbach's Alpha (measures dependability, i.e. the interaction between the individual and the items as a whole); 1) 0.5: Poor; 2) 0.5-0.6: Poor; 3) 0.6-0.7: Fair; 4) 0.7-0.8: Good; 5) > 0.8: Excellent.

Procedure

This research was conducted in three stages, namely the preparation stage, the implementation stage, and the data processing and data reporting stage. In detail, it is explained as follows; 1) Research Preparation Stage. The preparation stage begins with conducting pre-research at SMA Negeri A Sukoharjo to find problems that occur in the classroom. Then proceed with preparing a research proposal. The proposal preparation stage is carried out by compiling chapters I, II, and III based on the format provided and using relevant sources.The next step is making learning devices. Making learning devices is done by preparing learning devices in the form of learning modules, materials, media, and student worksheets. Furthermore, after the learning device is complete, it is continued with the preparation of the instrument and its validation. Preparation of instruments to measure students' science process skills and student scientific attitude questionnaire. The instruments were then tested for validity and reliability 2) Research Implementation Stage. The first step in the research implementation stage is to determine the treatment sample class. Selection of experimental and control classes based on normality test and homogeneity test. After the data is declared normal and homogeneous, proceed with the Anova test to determine the average class group whether there is a difference in initial ability or not. After it was declared that there was no difference, 2 classes were randomly selected to be used as experimental classes and 1 class for the control class. Class X2 was treated using a blended discovery learning model with a bioenial website, class X4 was treated with a discovery learning model, and class X5 was treated with a conventional model. The treatment given was posttest only control group design to measure science process skills and pretest-posttest nonequivalent control group design to measure scientific attitudes 3) Data Processing and Research Data Reporting Stage. The analysis stage begins with the organization of all research data obtained. Prerequisite tests were carried out with normality test, homogeneity test, and linearity test. Analysis of science process skills data using ANOVA hypothesis test while scientific attitude data using ANCOVA (Analysis of Covariance) hypothesis test. Analysis of the research data obtained and connected with the basics of existing research was carried out. This stage includes writing the research as a whole with systematic preparation in the form of a thesis. The report writing stage with the process of

describing descriptive statistics for each variable. Furthermore, a discussion is carried out for each hypothesis proposed to arrive at the conclusion of the research.

Data Analysis Techniques

The data obtained in the study will be processed and analyzed using SPSS version 25. Before processing in SPSS, the raw data was first converted into logit values through the Winstep application. After obtaining the logit value, it can conduct prerequisite tests, hypotheses, and further tests. Hypothesis testing is carried out after the prerequisite test which includes normality test, homogeneity test, and linearity test. The data analysis technique in this study used ANOVA test for SPS and ANCOVA for scientific attitude at the significance level $\alpha = 0.05$. Further tests used in ANOVA and ANCOVA analyses use LSD (Least Significant Difference) to determine which treatments are significantly different. If the sig value < 0.05 then the treatment is significantly different and if the sig value > 0.05 then the treatment is not significantly different.

RESULTS AND DISCUSSION

Based on the results of the calculation, it shows that integrating blended discovery learning with the bioenial website has an effect on students' science process skills on environmental change material. The experimental class with the blended discovery learning model is the best class for empowering SPS because it has the highest average among experimental classes using the discovery learning model and control classes using the problem-based learning model. Learning using the bioenial website with a blended discovery learning model involves student work in groups and learning activities through learning experience features that are realized in the form of text, files, and photos. Students' science process skills can be empowered when students do activities on learning experiences so that they can affect students' posttest scores. In accordance with Abriyanto et al., (2022), stated that the web-based Blended Learning LKS on environmental pollution material used in the learning process can improve students' SPS. Bar Diagram of Science Process Skills for each Indicator in Experimental Class and Control Class Figure 1.

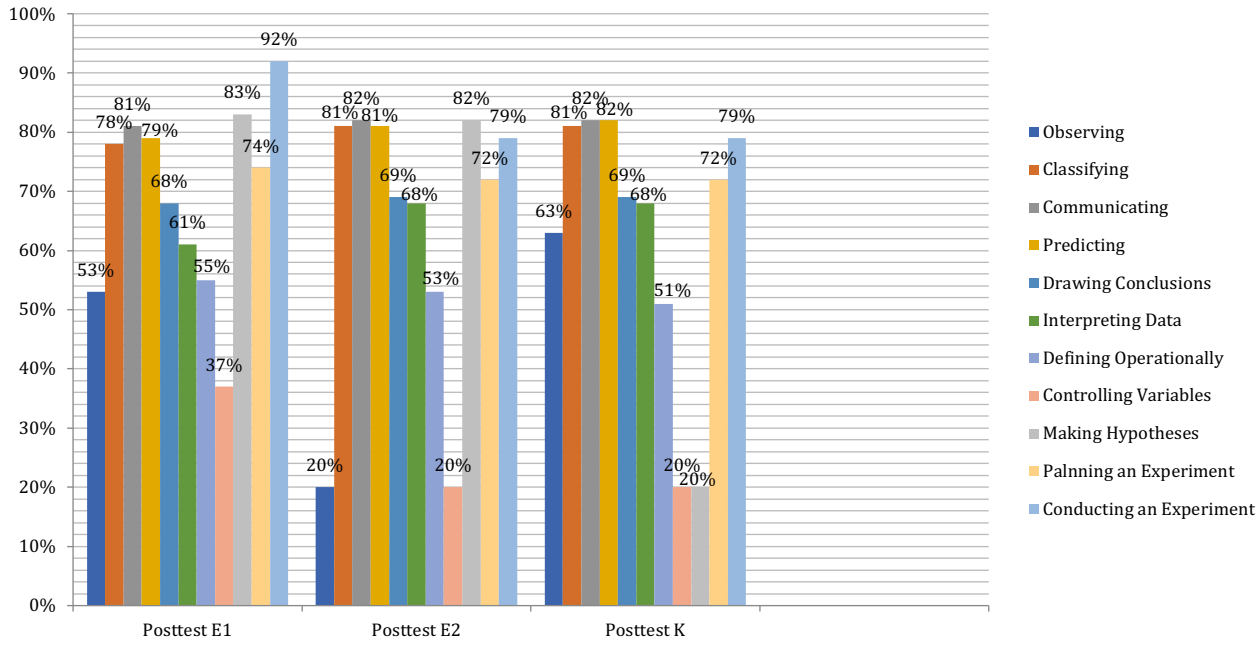

Figure 1. Bar Diagram of Science Process Skills for each Indicator in Experimental Class and Control Class

In general, SPS empowerment in the experimental group using the blended discovery learning model with the bioenial website has better posttest data results for science process skills than the experimental class using the discovery learning model and the control class. Blended discovery learning is a discovery learning process whose implementation is strengthened by online media so that learning activities can be carried out offline and online. The learning process can be facilitated by using blended learning-based website media because with this website students can play an active

role and can learn independently (Haka et al., 2020).The discovery learning model can help students in the process of understanding concepts through scientific activities such as practicum. The existence of practicum can activate students in linking information that has been owned with newly obtained information (Octovi, 2017). A summary of the results of the ANOVA further test using LSD can be seen in Table 3.

Table 3.
Summary of Anova Further Test Results with LSD

Class	Average	LSD Notation	
K	-1,882	a	
E2	-1,582	a	b
E1	-0,901		b

The empowerment of SPS between the experimental class using the blended discovery learning model and the experimental class using discovery learning has results that are not much different. Basically, the discovery learning model consists of learning syntax that supports the empowerment of SPS aspects (Octovi, 2017). In the syntax of science stimulation and problem statement, students are stimulated by the introduction of images and dialogue, which encourages them to recognize difficulties by asking related questions. Students are also encouraged to find answers to the questions asked in the data collecting syntax. Students are encouraged to obtain relevant data by using data collection syntax. Students process the data and information collected through the data processing syntax. Students' authenticity and confidence to voice their opinions are tested at this stage. Students perform checks in the verification syntax to prove the hypothesis. At the generalization stage, students are taught to make conclusions based on the results of the experiment which is actually a concept that they have successfully created through a series of science experiments.

The empowerment of SPS between the experimental class using the blended discovery learning model and the control class has different results. When viewed from the average posttest data results of science process skills, the experimental class using blended discovery learning has a higher average result than the control class. This difference can occur due to differences in the use of syntax and learning media used and the condition of students in each class. In line with the research of Abriyanto et al. (2022), learning media is something that is needed in the learning process. The use of e-learning-based learning media in the form of websites can help visualize learning materials and learning becomes student oriented (Palennari et al., 2018). According to Sadikin et al. (2020), when learning materials are integrated into the website, students can access them anytime and anywhere, making it easier for them to learn. Blended learning that integrates online learning and face-to-face learning has a greater effect than flipped learning (Antonio, 2022).

The control class in this study used a different learning model, namely problem-based learning. Empowerment of SPS in the control class with the experimental class using the discovery learning model was not significantly different in the results of the SPS posttest scores. There is no difference in the results of the SPS posttest of the PBL model with DL because both models as a whole are able to empower SPS indicators. Learning that uses discovery learning and problem-based learning involves students to conduct experiments, so that students will get a direct learning experience which will also be easier to be able to embed the concepts given (Hasanah et al., 2017).

In this study, the use of bioenial websites in blended discovery learning aims to empower students' SPS. Science process skills facilitate science learning, ensure students' active participation, and train them in learning, as well as train them how to think and work like scientists (Dwianto et al., 2017). Science process skills are divided into two, namely basic process skills and integrated process skills. Bar Diagram of Scientific Attitude for each Indicator in Experimental Class and Control Class Figure 2.

The calculation results show that integrating blended discovery learning with the bioenial website has no effect on students' scientific attitudes on environmental change material. This is indicated by the sig value. < 0,05. Incomplete research data and student inactivity during learning may be the main cause of the lack of influence of learning models on scientific attitudes. Both discovery learning and problem-based learning models require a long time to solve a problem until students find their own concepts. In addition to the lack of time, another issue that may contribute to this problem is

the lack of student readiness to carry out learning activities using the learning model used. The learning model is one of the external elements that only helps teaching and learning activities so that it cannot change students' attitudes in a short time because attitudes are influenced by many other factors (Jazuli et al., 2019).

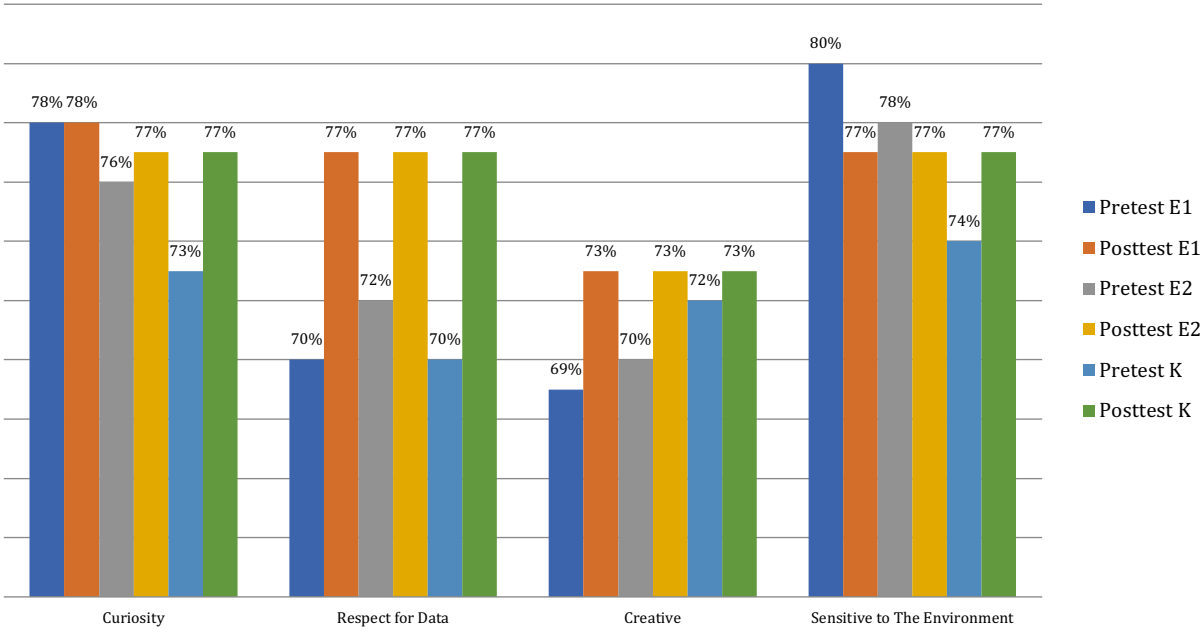

Figure 2. Bar Diagram of Scientific Attitude for each Indicator in Experimental and Control Class

Attitude is the tendency to react favorably or unfavorably to a given stimulus. If this reaction is in accordance with the ethics of science, then it is a scientific attitude (Olasehinde & Olatoye, 2014). According to Jazuli et al. (2019) attitudes cannot be obtained in an instant but can be applied through habituation. The process of habituation and experience certainly takes a long time. For example, if students are used to being passive and do not care about the environment and in class only play cellphones, then changing them to be active in learning activities and caring about the environment in just two or three meetings will be very difficult. In addition, a person's mental and physical condition can also give diverse results on the attitude displayed. A positive attitude towards science learning will contribute highly to the formation of students' scientific attitudes (Yunita et al., 2019).

Although there is no effect of discovery blended learning on scientific attitudes, the pretest value of the environmentally sensitive indicator occupies the highest position with an average value of 80% including the high category and the creative indicator occupies the lowest position with an average value of 69% including the moderate category. The high indicator of environmental sensitivity can occur because students are already aware of the environment, how to protect and care for the environment. The creative indicator is in the moderate category because some students still rely on their friends, so there are not many ideas submitted.

Scientific attitudes according to Harlen (2006), include: curiosity, respect for data / facts, critical thinking, discovery and creativity, open-minded and cooperative, perseverance, care for the environment. The scientific attitudes of students measured in this study include; 1) Curiosity which is shown from students who are able to provide several questions for the curiosity they want to have 2) Respect for data is shown from students who can provide conclusions according to the data they have 3) Creative is shown from students who are able to create works and easily accept changes in their ideas 4) Environmentally sensitive is shown by their concern for the environment such as recognizing and observing codes of conduct that protect the environment from waste, damage, and disturbance. The weaknesses of this research are the limited number of observers to help with observation activities, the incomplete condition of the research data class and student inactivity during learning, lack of time, and other problems that may contribute to this problem are the lack of student readiness to carry out learning activities using the learning model used. The learning model is one of the external elements that only helps teaching and learning activities so it cannot change students' attitudes in a short time because attitudes are influenced by many other factors (Jazuli et al., 2019).

CONCLUSION

Based on the analysis of the research data, it can be concluded that 1) There is an effect of integrating the blended discovery learning model with the bioenial website on students' science process skills on environmental change material; 2) There is no effect of integrating the blended discovery learning model with the bioenial website on students' scientific attitudes on the material of environmental changes.

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