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Development of Science Learning E-Modules Using the Pbl Model with Ethnoscience Approach

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ABSTRACT

The objective of this investigation was to create PBL-based ethnoscience-based e-modules for science instruction at Kota Padang's medium level school (SMP). For research and development (R&D), this study employs the ADDIE development paradigm, which involves five stages: analysis, design, development, implementation, and evaluation. Students at Padang's junior high schools' seventh grade served as the study's subjects. The study was conducted at Padang City Middle School. Interviews, questionnaires to assess the suitability of the media, tests to assess the efficacy of the media, and documentation were used as data collection techniques in this study. The test was carried out in phases, with individual trials, small group trials, and field trials with large groups all taking place after a review with media and material professionals. An extremely valid category with an average of 94% was revealed by expert validation. The students at the three universities rank the practicality test in the very practical area on average, while the teacher gives it an extremely practical rating of 90%. The results showed that PBL-based science instruction using E-Modules in the three schools was beneficial, with significant differences between the experimental group and the control group (p=0.001). As a result, the ethnoscientific perspective-based PBL model-based E-Module for science education qualifies as valid, helpful, and effective.

Keyword: E-Modul, PBL, Etnosains, Model ADDIE

INTRODUCTION

Gaining a comprehensive understanding as opposed to just insight is more stressed when learning with an ethnoscience approach. (Azima et al., 2016; Azima et al., 2017; Azima et al., 2018; Syukri et al., 2019; Thammawong et al., 2019) Students learn to connect class information to the context in their lives and the relationship between science and technology. Ethnoscience is in line with the Independent Curriculum's requirements that instruction be contextually based to aid students in creating their own knowledge and be connected to the cultural knowledge that is naturally present in students' daily lives (Mayda and Abdurahman, 2021). More crucial success indicators include the capacity to interact, exchange, and use information to tackle challenging issues, adapt and innovate in response to brand-new demands and shifting circumstances, and expand the capacity of technology to create new knowledge.

From services that focus manufacturing to services that favor information and expertise, there has been a significant shift in the last century. Knowledge itself is growing and expanding at an exponential rate. Information and communication technology have changed the kind of work we can complete, how we learn, and the importance of social interactions. Shared decision-making, information sharing, teamwork, innovation, and work tempo are essential nowadays. Students are urged to quit focusing on excelling in manual labor, routine machine-assisted work, or jobs that rely on the low wage of the labor market.

Success in the modern world can be determined by a person's ability to communicate, exchange, and use information to solve complex problems, adapt and innovate in response to new requirements and shifting situations, and improve the power of technology to create new knowledge (Rini et al., 2021). New standards are needed if pupils are to be equipped for the twenty-first century. In order to help children succeed in school and in life, schools struggle with how to teach them to think creatively, solve issues in a variety of ways, collaborate, and innovate. The importance of 21st century skills in bringing about the required transition is highlighted in a number of publications, including Trilling and Fadel (2009) and Ledward and Hirata (2011).

Knowledge, understanding, competence to live, and competence to act are the four perspectives on learning put out by the International Commission on Education for the 21st Century. These four concepts are provided by Delors (1998). Learning to know, learn to do, learn to be, and learn to live together are added to this vision as the four pillars of education. This framework is still regarded as being applicable to current issues in education and can be changed to meet the demands of the twenty-first century (Scott, 2015). One method to help students learn how to solve problems while studying physics is problem-based learning.

When studying physics, using this learning model application helps improve students' problem-solving skills. The main goal of problem-based learning is to expose students to various real-world, pertinent problem situations so they can utilize them as a springboard for further investigation and the improvement of their problem-solving skills (Tan et al., 2021). Students can learn more about science subjects and become better problem solvers by using a problem-based learning strategy. As a result, it is crucial to think about how problem-based learning models might be used in these three domains. This study sought to examine student knowledge, problem-solving abilities, and scientific method skills in relation to the application of problem-based learning in physics education. The purpose of this study is to investigate whether the questioned learning paradigm has a positive impact on the aforementioned competencies. The PBL model used in this work is that proposed by Yanto et al. (2021), and it covers methods for analysis and problem-solving along with observation, problem formulation, problem analysis, data collection, hypothesis testing, generating and presenting.

Literature Review

The goal of education in all subject areas today is to help students develop their problem-solving and critical thinking skills (Elder & Paul 2012; Olszewski-Kubilius & Thomson 2015). The study of science has benefited greatly from the shift in teaching and learning activities from passive to active, from traditional to contemporary innovative teaching, and from passive listeners to active learners. Junior high students should focus on physics because it is a subject that greatly advances knowledge, particularly in the applied sciences like technology, mechanics, medicine, and marine science. Williams et al. (2003) assert that physics is comprehensive for students to grasp since it considers how to find answers and acquire knowledge to resolve difficulties associated to learning.

Investigations show that more than 70% of the time is spent assigning structured assignments in the form of calculations or inquiries. Additionally, more than 60% of students are motivated by their hopes for the future and a strong desire to succeed. The application of practicum, interesting learning activities, encouragement, and needs in learning, which only account for a proportion of less than 50%, is inconsistent with teachers' use of learning models or strategies (53%), despite the fact that they have done so. In terms of utilization, printed teaching materials continue to dominate with a share above 60%, while the use of non-printed teaching materials is less than 30%. The results of physics education generally fall short of expectations.

Teachers are another element for students to struggle with learning physics due to their active involvement in the teaching and learning process (Ekici; 2016). The 2009 study by Alptekin and colleagues found that students believed their lecturers were very important to their ability to understand physics. According to Aycan and Yumuşak (2003), one of the reasons why students struggle to study physics is the non-experimental and theoretical approach to the subject. Teachers are charged with the crucial duty of successfully controlling the educational process (Ekici; 2016). In order to improve students' aptitude for learning, particularly physics, finding alternative solutions requires more serious study from a number of groups.

The administration has made every effort to address the numerous problems that now plague the educational system. The government has developed a variety of standards in the field of education, including those that deal with protocols, evaluation, assessment, funding, facilities, and infrastructure, as well as changes to curricula. The 2013 curriculum, which prioritizes a scientific viewpoint, is now used in Indonesia. To include this methodology into the learning process, the 2013 curriculum suggests choosing a learning model, such as Problem Based Learning (PBL), Project Based Learning (PjBl), Discovery Learning (DL), or Inquiry Learning (IL) (Hosnan, 2014). The key component of problem-based learning (PBL), according to Afdareza, Yuanita, and Maimunah (2020), is the presentation of multiple scenarios that are actual and pertinent to students, enabling both investigation and investigation to be carried out. PBL is a paradigm of learning that makes students handle a problem utilizing each step of the scientific method, according to Utrifani and Turnip (2014). Students can learn more about the topic and develop their problem-solving abilities in this way.

Using the PBL Model and an Ethnoscience Approach, this study aimed to develop an E-Module for Science Learning in SMP Kota Padang. It is predicted that this innovation would facilitate instructional responsibilities for both students and teachers. In order to address problems with science education, particularly those involving the availability of a variety of teaching tools, SMP uses multimedia content. The results of the Science Learning E-Module using the PBL Model and an Ethnoscience Approach at Padang City Middle School will be demonstrated in this study.

METHOD

Research Design

The research is of the Research and Development (R&D) variety, and it follows the ADDIE paradigm, which has five stages: analyze, design, develop, implement, and evaluate. A team of specialists, including those with expertise in design, content, and language, tests the product's validity. Data for the analysis of practicality came from the observation tool used to monitor the implementation of the Science Learning E-Module Using the PBL Model with an Ethno-science Approach in Padang City Middle School with an ethno-science approach, using teacher assessment sheets and student assessment sheets for the developed E-Module. Two-way ANOVA analysis was then used to measure the effectiveness.

Table 1 Factorial design of two-way ANOVA

Model School Category	(Experiment)	(Control)
High (A)	X1Y1	X2Y1
Moderate (B)	X1Y2	X2Y2
Low (C)	X1Y3	X2Y3

The experiment was carried out in four meetings with the subject matter of classification of living things. To investigate the effectiveness of the Science Learning E-Module Using the PBL Model with an Ethnoscience Approach in Padang City Middle School, it was observed using an assessment sheet at each meeting. Furthermore, the effectiveness of the Science Learning E-Module Using the PBL Model with an ethnoscience approach to learning outcomes (cognitive domain) was assessed from the results of the post-test scores of students in the experimental class using test items of learning outcomes. hypothesis testing for the effectiveness test was a 2 x 3 factorial design. Statistical analysis for the two-way Anava test used the SPSS version 26 application. Before the two-way Anava test was carried out, a prerequisite test was first carried out, namely the normality test using the Kolmogorov-Smirnov test and the homogeneity test using the Levene. Population and sample. In this study to test the validity there were 4 expert validators consisting of linguists, content, design and experts in technology as well as science teachers and class VII students of public junior high schools in Padang City, namely, SMP N 1 Padang, SMP N 34 Padang and SMPN 35 Padang. The research instruments used to collect data were assessment sheets and learning achievement test questions. While data analysis to test the validity and practicality tested by looking at the percentage and adjusted to the criteria $80\% < x \leq 100\%$ (very valid/practical), $60\% < x \leq 80\%$ (valid/practical), $40\% < x \leq 60\%$ (Quite valid/practical) $20\% < x \leq 40\%$ (less valid/practical) and $0\% \leq x \leq 20\%$ (not valid/practical). while the test data for the effectiveness of web-based E-Modules in science learning with an ethnoscience approach were analyzed by a two-way ANOVA test with a significance level of 5% using SPSS 26 software. The decision-making criterion is if the significant value (p) at the SPSS output is less than 0.05 then H1 is accepted.

RESULT AND DISCUSSION

Development of Web-based learning E-Modules through 5 stages of analysis, design, development, implementation, and evaluation as follows:

In the 1st activity the analysis carried out was collecting data related to the problems encountered in current learning which then identified solutions to overcome the problems that occurred. The purpose of this needs analysis is to identify problems and find out the causes of problems in the learning process. Data at this needs analysis stage were obtained by conducting interviews with the Padang City Education Office and several schools that were the destinations for the research. From the results of the discussion and analysis carried out, it was found that the development of the Science Learning E-Module Using the PBL Model with an Ethnoscience Approach in Padang City Middle School is important to be developed to meet the current learning needs in Padang City Middle School and create a learning atmosphere that is contextual and fun and able to solve problems. learning problem.

In the 2nd activity the design is carried out to make a product development design. At this stage, the design of interactive e-modules that will be used in research is carried out. As for the design that was made, namely the design of an interactive e-module using the PBL model with an ethnoscience approach. The e-module material design was made using the articulate storyline 3 application. This application is one of the applications used to create interactive learning media with content in the form of text, images, video, sound, and animation. E-modules are made interactive by adding several buttons that can be clicked when used.

In the 3rd activity, namely the product development stage, at this stage the validity and practicality of the product are carried out. After the interactive e-module product with a web-based ethnoscience approach is designed/designed, the next step is the validation stage. Validation is carried out to assess the validity of the product made. The components of the validation questionnaire include the appropriateness of the content, language, presentation and graphic design of the resulting e-modules. The data obtained is used to reveal the validity level of the designed e-module. Based on the results of the validation of the e-module that has been carried out by the validator with an average value of 94% with a very valid category, this identifies that the Ethnoscience-Based Integrated Science e-module on the Material of the Nature of Science, Measurement and Scientific Methods for class VII students is very valid from aspects that have been given. for the results of the product validity test developed can be seen in the following table:

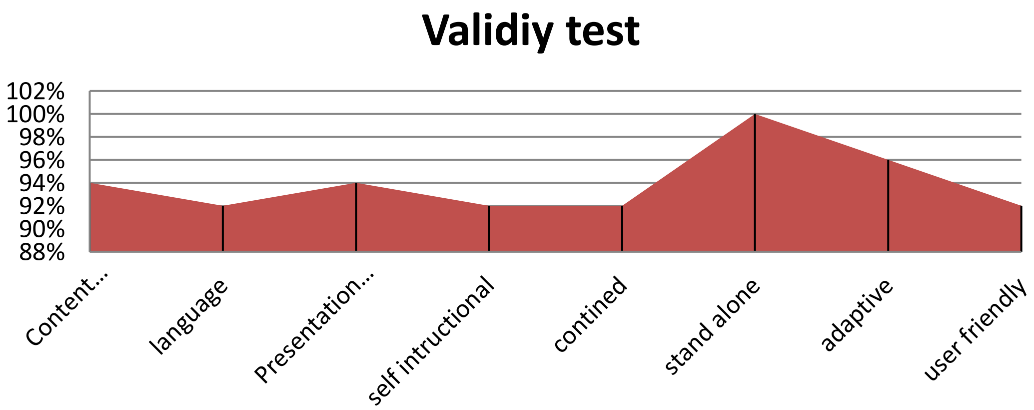

Figure 1. Product validity test results

The practicality test is carried out by involving teachers, students, and observers. The practicality stage is carried out to test the feasibility of the product being developed. The data obtained from this practicality stage is used to reveal the practicality level of the designed e-module. Complete practicality value calculation data by teachers and students can be seen in the following graph:

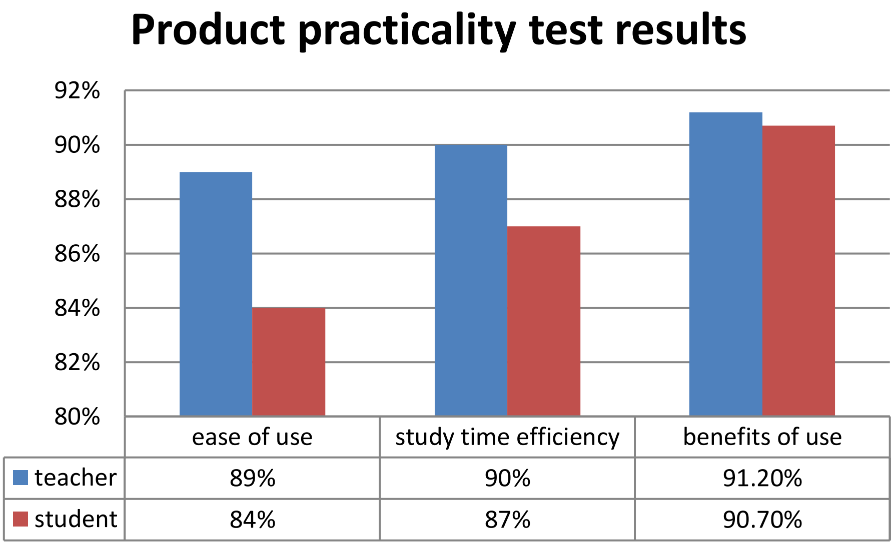

Figure 2. Product practicality test results

Based on the graph above, the average practicality by teachers is 90% (very practical) and practicality by students is 87% (very practical) in terms of the aspects of ease of use, efficiency of learning time and benefits of use. So that the developed e-module is very practical to use by teachers and students in terms of ease of use, efficiency of study time, and benefits of use

In activity 4, implementation was carried out by testing web-based e-modules directly through the learning process. This activity was carried out in several schools in the city of Padang, including SMPN 1 Padang, SMPN 3 Padang, SMPN 8 Padang, SMPN 22 Padang, SMPN 34 Padang, SMPN 35 Padang, SMPN 36 Padang and SMPN 40 Padang. At the Implementation stage, the first activity carried out was to divide the class for research, namely into a control class and an experimental class with an average learning value that was almost the same. The control class was carried out using the usual learning method which was carried out by the teacher on a daily basis while for the experimental class the learning method was carried out using the website. The stages carried out in the experimental class were the delivery of learning material with web-based e-modules to class VII junior high school students using a computer or cellphone lab.

Table 2. Normality Test Results

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
SMP 1	experiment	0.148	27	0.133	0.961	27	0.388
	control	0.151	27	0.117	0.941	27	0.126
SMP 34	experiment	0.119	27	0.200*	0.945	27	0.162
	control	0.164	27	0.059	0.940	27	0.124
SMP 35	experiment	0.163	21	0.149	0.943	21	0.254
	control	0.170	21	0.114	0.930	21	0.140

a. Lilliefors Significance Correction

Based on the table above, the three schools above, both the experimental class and the control class, show a significance value of > 0.05 using both the Kolmogorov-Smirnova analysis and the Shapiro-Wilk analysis, meaning that the three classes are normally distributed, then the following table describes the results of the homogeneity test for the three classes in the experimental class as follows

Table 3. Homogeneity Test Results

Levene's Test of Equality of Error Variances[a,b]

		Levene Statistic	df1	df2	Sig.
Score	Based on Mean	1.950	5	154	0.089
	Based on Median	1.655	5	154	0.149
	Based on Median and with adjusted df	1.655	5	116.464	0.151
	Based on trimmed mean	1.863	5	154	0.104

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.
*a. Dependent variable: VALUE b. Design: Intercept + SCHOOL + LEARNING MODEL + SCHOOL * LEARNING MODEL*
*a. Dependent variable: VALUE b. Design: Intercept + SCHOOL + LEARNING MODEL + SCHOOL * LEARNING MODEL*
Based on the results of the analysis carried out above, the data is homogeneously distributed with a significance value of > 0.05, meaning that the data is homogeneously distributed, then it can be continued to test the hypothesis using a two-way ANOVA analysis with a 2 x 3 factorial design. Statistical analysis for the two-way Anava test uses the SPSS version 26 application. the results of the analysis are in the following table:

Table 4. Two-Way ANOVA Test Results

Tests of Between-Subjects Effects

Dependent Variable: Score

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	17814.971[a]	5	3562.994	22.461	<.001
Intercept	849676.068	1	849676.068	5356.426	<.001
SCHOOL	5086.188	2	2543.094	16.032	<.001
LEARNING METHOD	1308.357	1	1308.357	8.248	0.005
SCHOOL * LEARNING METHOD	11547.830	2	5773.915	36.399	<0.001
Error	24428.623	154	158.627		
Total	920625.000	160			
Corrected Total	42243.594	159			

a. R Squared = .422 (Adjusted R Squared = .403)

The significance score of the learning model aspect is less than 0.05, namely 0.001. This shows that H1 is accepted, which means that there is a significant difference in the level of E-Module use using the ethnoscience-based PBL model in science learning between the experimental group using the E-Module using the PBL model in science learning with an ethnoscience approach and the control group using conventional learning. The significance value of the school aspect is less than 0.05, namely 0.005. This shows that H1 is accepted, which means that there is a significant difference in the use of web-based E-Modules in science learning with the ethnoscience approach in the experimental group in the three school categories. The significance value of the interaction between aspects of using web-based E-Modules in science learning with an ethnoscience approach and school categories is smaller than 0.05, namely 0.01. This shows that H1 is accepted, which means that there is an interaction between the e-module variables using the PBL model and the school category variables.

Apart from the results of the two-way ANOVA test above, it can also be seen the results of the interaction of the three schools based on the graph below:

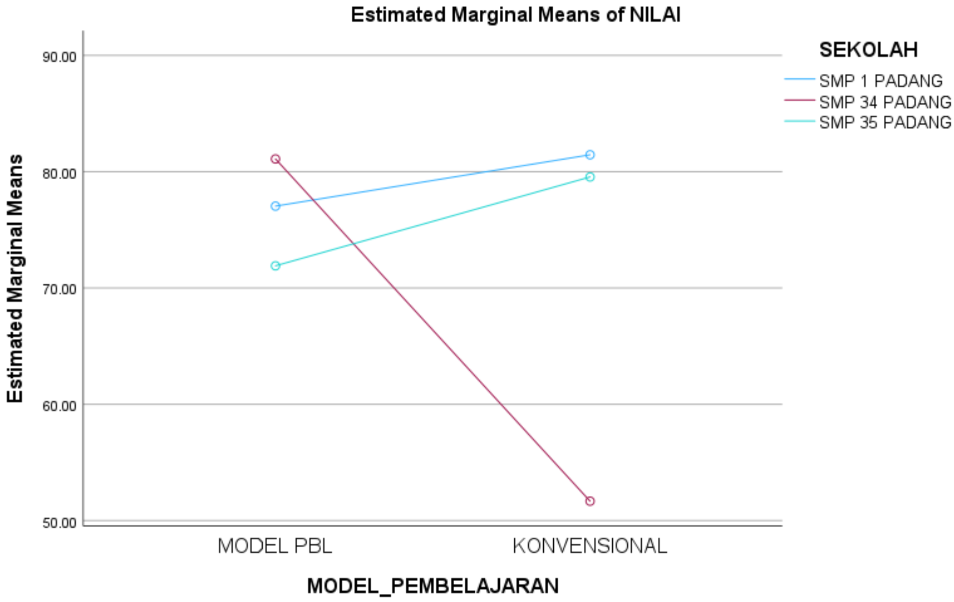

Figure 3. Graph of Interaction of the three Schools

Based on the graph above it can be concluded that SMP 1 Padang in the experimental class increased while SMP 34 experienced a not so significant increase while SMP 35 experienced a slight decrease

Table 5. Post Hoc Tests

Multiple Comparisons						
Dependent Variable: Score						
Tukey HSD						
(I) SCHOOL	(J) SCHOOL	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
SMP 1 PADANG	SMP 34 PADANG	11.7694*	2.32885	<,001	6.2580	17.2809
	SMP 35 PADANG	3.5826	2.53455	.336	-2.4157	9.5809
SMP 34 PADANG	SMP 1 PADANG	-11.7694*	2.32885	<,001	-17.2809	-6.2580
	SMP 35 PADANG	-8.1868*	2.52539	.004	-14.1634	-2.2103
SMP 35 PADANG	SMP 1 PADANG	-3.5826	2.53455	.336	-9.5809	2.4157
	SMP 34 PADANG	8.1868*	2.52539	.004	2.2103	14.1634
Based on observed means.						
The error term is Mean Square(Error) = 158.627.						
*. The mean difference is significant at the ,05 level.						

Examine at the Mean Difference (I-J) column in the Multiple Comparison table; some rows have stars (*) and some don't (*). When a model is designated with a *, it differs considerably from other models in that category. Therefore, it can be said that there is a big difference between the 3 schools. The improvement in students' knowledge competency is then used to determine the effectiveness model. Data analysis revealed that using the PBM-PF Model resulted in a higher improvement in student knowledge learning outcomes than using other types of instruction that did not use problem-based learning. These findings support Jonassen's (1997) contention that problem-based learning requires a variety of cognitive tasks, including the use of proportional information, concepts, rules, and other knowledge-based ideas. Additionally, using structural knowledge is necessary for problem solving. covers mental models, concept maps, networks, and semantic mapping. Problem-based learning also incorporates practical abilities including the creation and use of justifications, comparisons, and conclusions. Additionally, motivation and attitude are involved in problem-based learning, according to Jonassen & Tesmer (1966). According to the efficacy test findings, problem-based learning models for learning physics can enhance learning outcomes in terms of knowledge, problem-solving abilities, and attitudes. The aforementioned opinion supports these findings. According to Kyu & Ph (2015), students can get learning experience at a higher level of knowledge structure through problem-based learning that incorporates real assessment.

DISCUSSION

The main component of problem-based learning (PBL) is the presenting of numerous situations that are real and significant to the students so that they can serve as a basis for both conducting and being the subject of studies (Arends, 2008). PBL, according to Utrifani and Turnip (2014), is a model of learning that has students work through each stage of the scientific method to solve a problem in order to gain knowledge about the issue and problem-solving skills.

The validation test phase was carried out to assess the design of teaching materials in the form of Ethnoscience-based Integrated Science e-modules. In theory, an instrument for measuring the level of validity of a product must contain the content of questions or statements in the instrument relating to suitability, correctness, clarity, accuracy and validity. According to **Gebre (2018)** stated that the valid validation results show that teaching materials have been able and appropriate to be used as teaching materials in the learning process. It also stated that teaching materials that are suitable for use in the learning process are teaching materials that have been declared valid by the validator. Based on the results of practicality for teachers related to aspects of the benefits of use, a percentage of 94% is obtained in the very practical category. And the results of practicality carried out on students related to aspects of the benefits of use get a percentage of 90% in the very practical category. The practicality category of the IPA e-module on the aspect of the benefits of use is in the range of 81-100%. The aspects of the benefits of using e-modules by teachers and students are considered very practical. Practical relates to how easy it is to use a product. The practicality test aims to see how the convenience offered by the product is implemented or used in an activity. This shows that teachers can act as facilitators in learning because e-modules can help students learning because the e-module presents images and videos that make it easier for students to understand learning material. This is in accordance with the opinion **(Weng et al., 2018)** that e-modules can be used by teachers as an alternative teaching material in increasing students' understanding of concepts. The overall results of practicality for teachers and students obtained an average percentage of 93% of teachers and 88% of students with each very practical category. Student knowledge can increase along with increasing student activity in learning **(Damyanov, I., & Tsankov, N, 2018)**. The use of web-based E-Modules in science learning with an ethnoscience approach is proven to increase students' knowledge competence in learning. Electronic modules are modules developed using information and communication technology that can display text, audio, video or animation and are equipped with evaluation tests where users can get feedback **(Sommers et al.,2019)**. The ethnoscience approach, according to Margono (2004), is a method for developing a learning environment and designing learning experiences that incorporate culture as a part of the learning process. Students must become literate in science and technology through scientific education. The process of learning both scientific and non-science, according to Sudarmin (2014), must be able to incorporate regional cultural values. Local learning environments can enhance students' capacity for original thought. The acknowledgement of local culture as a fundamental (fundamental and significant) component of education will be perceived by students as the basis for learning with entosanins (Atmojo, 2012). The guidance of students in identifying and developing their own knowledge based on the understanding that has evolved in society is another objective of ethnoscience-based science education.

CONCLUSION

E-Modules using the PBL model in science learning with an ethnoscience approach have been assessed by experts with very valid categories from several aspects including Content Feasibility Aspects, Linguistic Aspects, Presentation and Graphic Aspects, Self Instructional Aspects, Contained Aspects, Stand Alone Aspects, Adaptive

Aspects , Aspects of User Friendly with an average of 94%. Whereas in terms of the practicality aspect of the E-Module using the PBL model in science learning with an ethnoscience approach, the practicality test results show that the average practicality by teachers is 90% (very practical) and practicality by students is 87% (very practical) in terms of ease of use, efficiency of study time and benefits of use. Then on the effectiveness aspect, the results showed that there were significant differences in the use of E-Modules using the PBL model in science learning with an ethnoscience approach between the experimental group and the control group in the three schools (p=0.01). There were significant differences in the experimental group in the three school categories (p=0.01). And there is an interaction between the E-Module using the PBL model in science learning with an ethnoscience approach in the three schools

Thus, this study contributes to implementing the E-Module using the PBL model in science learning with an ethnoscience approach in junior high school. In addition, education practitioners and policy makers can consider implementing E-Modules using the PBL model in science learning with an ethno-science approach that is relevant in the current era, and is an option towards digitizing education in the future.

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