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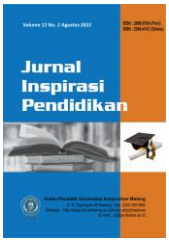

Effectiveness of E - Module Implementation Using STEM Project-Based Learning on Statistics Materials

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ABSTRACT

Tujuan dari penelitian ini adalah untuk mengetahui efektivitas penerapan e-modul berdasarkan pembelajaran berbasis STEM Project pada materi statistik. Metode yang digunakan dalam penelitian ini adalah analisis data kuantitatif. Analisis data kuantitatif menggunakan N – gain yang bertujuan untuk mengetahui efektivitas modul E - Modul STEM Project - Based Learning dalam satu kelompok penelitian desain pretest-posttest. Populasi yang digunakan dalam penelitian ini adalah seluruh siswa kelas VIII SMPN 1 Purwosari dengan total 327 siswa. Sampel penelitian ini diambil secara acak dengan teknik cluster random sampling. Berdasarkan hasil pengambilan sampel, ditemukan ada 10 siswa di kelas VIII A (small group test) dan 32 siswa di kelas VIIIB (large group test). Kelas VIII A bertindak sebagai kelas eksperimen dan Kelas VIII B adalah kelas kontrol. Berdasarkan hasil penelitian, ditemukan bahwa E - Modul Menggunakan STEM Project Based Learning dinilai efektif bila diterapkan pada kelas VIII A dan VIII B SMP N 1 Purwosari. Hal ini berdasarkan uji N – Gain, hasil penelitian menunjukkan bahwa nilai rata-rata kelas VIII A adalah 59, 35 atau 59,35%, termasuk kategori yang cukup efektif, dengan nilai perolehan N minimum 14% dan maksimum 67%. Sedangkan hasil nilai rata-rata untuk kelas VIII B adalah 60,41 atau 60,41% termasuk kategori efektif, dengan nilai N-gain minimal 14% dan maksimal 100%.

Keywords:
Effectiveness , *E – module,*
STEM Project–Based Learning,
Statistics

ABSTRACT

The purpose of this study was to determine the effectiveness of the application of e-modules based on STEM Project-based learning on statistical material. The method used in this research is quantitative data analysis. Quantitative data analysis using N – gain which aims to determine the effectiveness of the E STEM Project Based Learning module in one group pretest-posttest research design. The population used in this study were all students of class VIII SMPN 1 Purwosari with a total of 327 students. The sample of this research was taken randomly with the cluster random sampling technique. Based on the results of sampling, it was found that there were 10 students in class VIII A (small group test) and 32 students in class VIIIB (large group test). Class VIII A acted as the experimental class and Class VIII B was the control class. Based on the results of the study, it was found that E - Module Using STEM Project Based Learning is considered effective when applied in class VIII A and VIII B SMP N 1 Purwosari. This is based on the N - Gain test, the results show that the average value of class VIII A is 59, 35 or 59.35%, including the category quite effective, with a minimum N - gain value of 14% and a maximum of 67 %. While the results of the average value for class VIII B is 60.41 or 60.41% including the effective category, with a minimum N-gain value of 14% and a maximum of 100%.

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Introduction

Learning in the 4.0 revolution era requires us to use the internet of things (IoT) in learning to improve students' cognitive abilities and skills. Cognitive abilities and skills that need to be improved are Critical Thinking and Problem Solving, Communication, Collaboration, Creating and Innovating (Ferdiani et al., 2022). However, the reality on the ground is that students in Indonesia have low creative thinking skills. Based on research conducted by TIMSS in 2011, Indonesia was ranked 36th out of 48 countries for international mathematics scores for class VIII, especially in reasoning competence. The lack of reasoning ability is caused by the lack of student's creative thinking skills. Meanwhile, based on the analysis of the 2015 PISA results, Indonesia is ranked 46th out of 51 countries. Based on the results of the 2015 Global Creativity Index analysis, Indonesia is ranked 86th out of 93 countries, with a score of 7.95 in the creative class (Florida et al., 2015)

These cognitive abilities and skills can be improved through classroom learning, one of which is by applying STEM (Rusyati et al., 2020). STEM-oriented learning will shape the character of students who can recognize a concept or knowledge (science) and apply it with skills (technology) (Hassan Majeed et al., 2021) . Through STEM learning, students have scientific and technological literacy as seen by reading, writing, observing, and doing science (Wai et al., 2010). STEM Project - Based Learning can develop if it is associated with the environment so that it can create learning that presents the real world experienced by students in everyday life (Lanagan et al., 2019). They master creating or designing a method (engineering) with analysis and calculation of mathematical data (mathematics) to solve a problem. The benefits of the STEM approach make students problem solving better, innovative, independent, logical thinking, and technological literacy (Stohlmann et al., 2012). STEM learning can be applied with various learning models, one of which is Project Based Learning (Capraro, 2013).

The implementation of learning in schools, especially in schools, rarely applies STEM-based learning (Khoiriyah et al., 2018), (Ting et al., 2022). So far, learning at school rarely apply project-based learning models, this is due to the lack of understanding of teachers in implementing learning steps using project-based learning models (Ferdiani & Murniasih, 2017). Project Based Learning is defined as teaching that connects technology with familiar everyday life problems for students or school projects (Yona Okyranida, 2020). This model makes learning and student-centred activities carried out by collaborating with groups to complete projects according to design (Darmayanti & Pratiwi, 2019). STEM Project-based Learning is an effective combination because it requires students to play a role and increases students' creativity to learn (Li & Schoenfeld, 2019). STEM Project-Based Learning consists of five stages, namely: 1) The preparation stage, namely guiding students to understand the theme, scope, and problem. 2) The implementation stage is the stage that provides opportunities for students to produce projects according to their designs. 3) The presentation stage is a stage that requires students to present their projects. 4) The evaluation stage is a stage that requires teachers to provide evaluations or suggestions for projects carried out by students. 5) The correction stage is the stage that encourages students to make corrections according to the evaluation obtained (Lou et al., 2017).

To facilitate the implementation of STEM Project-based Learning in the classroom, learning media is needed, one of which is an e-module. E – module is very practical when used in learning (Diani et al., 2021a). E-module is a learning media that has an electronic format that is systematically organized and accompanied by animation, music, and navigation to make users more attractive to achieve learning goals (Asih et al., 2021). The use of e-modules in the learning process is not limited to the classroom, but can be done outside the classroom. E –module intended for this research is focused on junior high school statistics which discusses the distribution of data, average value, median, mode, and data distribution to conclude, make decisions, and make predictions.

Based on the observations of researchers at SMPN 1 Purwosari, it was found that the learning process carried out by the teacher was not optimal. This is because it has not used learning media that can support the delivery of material to students. In addition to the absence of learning media, the learning method used is only limited to providing material and followed by giving assignments. This

has an impact on student learning outcomes. Based on the analysis of student learning outcomes on statistical material, as many as 52% of class VIII A students have not reached the KKM.

Research related to the application of STEM in learning has been studied by several previous researchers, such as (Betty Heryuriani & Musdayati, 2020), (Rahmawati & Juandi, 2022), (Rizal Umami, 2022). However, previous research has not discussed the use of e-modules using STEM Project-Based Learning and its effectiveness when used in learning. This is a gap for researchers to examine the Effectiveness of E-Module Implementation Using STEM Project-Based Learning on Statistics Materials. This is by the problems found at the time of observation, it is necessary to have media innovation in learning. One of them is an E - module based on STEM Project-Based Learning. E - module based on STEM Project-Based Learning will assist students in studying statistical material, which can be accessed via cellphone or laptop so that it can be studied in class or outside class. The effectiveness of this e-module implementation needs to be tested so that its effectiveness can be measured if it is used in mathematics learning, especially in statistical material.

Method

The purpose of this study was to determine the effectiveness of implementing e-modules based on STEM Project-based learning on statistical material. The method used in this research is quantitative data analysis. Quantitative data analysis using N – gain which aims to determine the effectiveness of the E STEM Project Based Learning module in one group pretest-posttest design research. Effectiveness can be said as the impact or outcome arising from action, in this case, the impact of the use of e-modules on learning outcomes. The effectiveness test is carried out as a measure of the success rate of a learning process. E-modules can be said to be effective if they have a good impact on student learning outcomes. The results of the effectiveness test were obtained from the results of the posttest test by working on objective questions that had been previously validated. Effectiveness results are also obtained based on the results of practical assessments and project assignments carried out by students. The analysis of the effectiveness of the e-module is seen from the classical completeness obtained by comparing the post-test results with the KKM score set by the school. If the students' classical mastery has been achieved, the e-learning module is categorized as effective. It can be concluded that based on the KKM value, the learning outcomes after using the e-module are declared complete and the project-based learning STEM e-module is categorized as effective.

The population used in this study were all students of class VIII SMPN 1 Purwosari with a total of 327 students. The sample of this research was taken randomly with the cluster random sampling technique. Based on the results of sampling, it was found that there were 10 students in class VIII A (small group test) and 32 students in class VIIIB (large group test). Class VIII A acted as the experimental class and Class VIII B was the control class.

Results And Discussion

The purpose of our research is to determine the effectiveness of implementing e-modules based on STEM Project-Based Learning on statistical material. Before measuring the effectiveness of this E-module, the researcher developed this e-module. This development includes the stages of curriculum analysis, design design, and product development. Curriculum analysis is to determine the concept that will be used and adapted to the curriculum used in schools. Design is a systematic process that starts from determining the concept of the e-module that is made and designing the appearance of the e-module that is adapted to the existing curriculum. Product development is the stage where the design is realized into a finished product with various improvements in it. The following is an image of an e-module STEM Project-Based Learning.

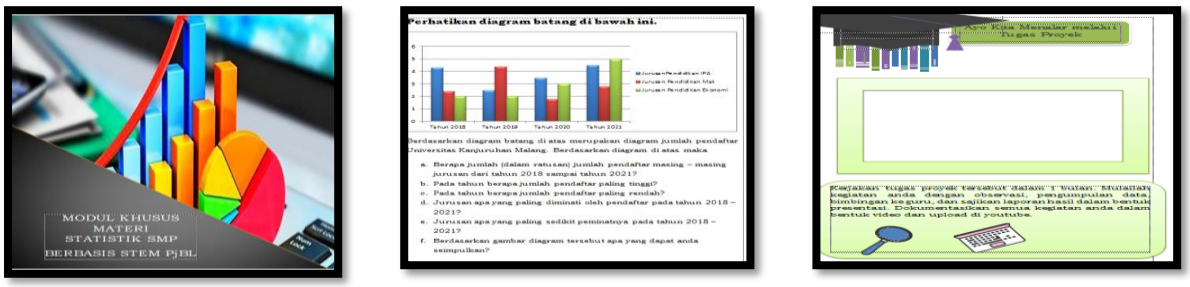

Figure 1
Display E-modules based on STEM Project-Based Learning

E –module intended for this research is focused on junior high school statistics which discusses the distribution of data, average value, median, mode, and data distribution to conclude, make decisions, and make predictions. E-modules can be accessed online either through laptops or smartphones. This e-module provides interactive questions and quizzes so that it can measure the level of mastery of the material at the end of the learning activity. This is an effort to overcome the weakness of the printed module, where the answer key can be seen by students. As this module was developed based on Project Based Learning, the E-module contains several authentic projects on statistical material.

Before testing the hypothesis, the analysis requirements test is carried out in the form of a normality test. A normality test is a test that is carried out to test whether the data is normally distributed or not. The assumption of normality is a prerequisite for most inferential statistical procedures. In this study, the normality assumption was explored using the Lilliefors Kolmogorov Smirnov normality test through SPSS with a significance level of = 0.05. Based on Figure 2, the results of the normality test for class 1 (VIII A/experimental class) and class 2 (VIII B/control class) are obtained.

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	kelompok kelas	Statistic	df	Sig.	Statistic	df	Sig.
N gain prosen	1	.187	10	.200*	.916	10	.328
	2	.107	32	.200*	.948	32	.130

*. This is a lower bound of the true significance.
a. Lilliefors Significance Correction

Figure 2
Normality test results for class 1 (VIII A/experimental class) and class 2 (VIII B/control class)

Based on the picture above, it can be concluded that the value of sig. for class 1 (VIII-A) of 0.328 more than 0.05, it can be said that the data is normally distributed or which means that it accepts H0. This can be proven by the normal graph of Q plot N – gain class 1 (VIII-A) which is presented in the figure below.

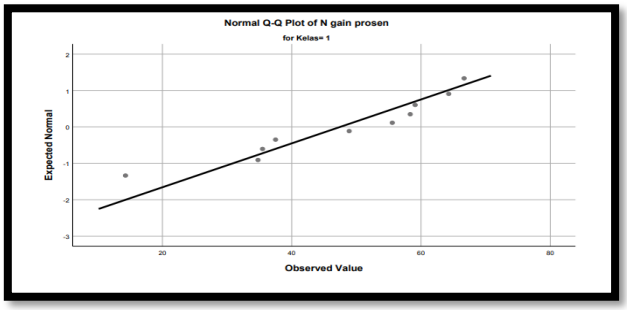

Figure 3
Normal graph Q plot N – gain class 1 (VIII-A)

Based on the figure above, it can be concluded that the plots follow the fit line, so the variables are normally distributed.

Based on Figure 2, the value of sig. for class 2 (VIIIB) of 0.130 more than 0.05, it can be said that the data is normally distributed or which means that it accepts H0. This can be proven by the normal graph of Q plot N – gain class 2 (VIIIB) which is presented in the figure below.

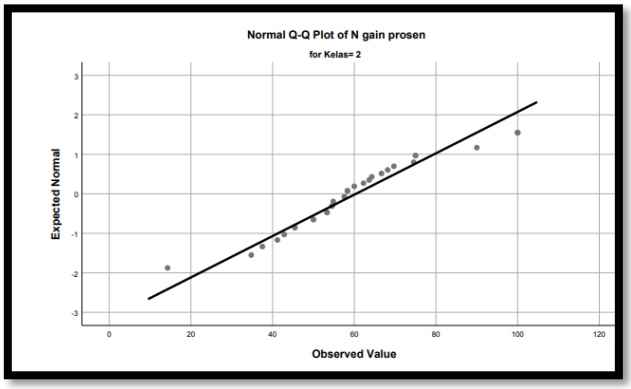

Figure 4
Normal graph Q plot N – gain class 1 (VIII B)

Based on the figure above, it can be concluded that the plots follow the fit line, so the variables are normally distributed. After carrying out the normality test, the result is that the data is normally distributed for class VIII A and class VIIIB, the next step is the N-gain test. This N-gain test aims to determine the effectiveness of the E STEM Project Based Learning module in the one-group pretest-posttest design research. Based on Figure 5, the results of the N-gain test are obtained for class 1 (VIII A/experimental class) and class 2 (VIII B/control class).

kelompok kelas			Statistic	Std. Error
N gain prosen	1	Mean	47.49	5.246
		95% Confidence Interval for Mean — Lower Bound	35.62	
		95% Confidence Interval for Mean — Upper Bound	59.35	
		5% Trimmed Mean	48.27	
		Median	52.22	
		Variance	275.218	
		Std. Deviation	16.590	
		Minimum	14	
		Maximum	67	
		Range	52	
		Interquartile Range	25	
		Skewness	-.797	.687
		Kurtosis	.049	1.334
	2	Mean	60.41	3.374
		95% Confidence Interval for Mean — Lower Bound	53.53	
		95% Confidence Interval for Mean — Upper Bound	67.29	
		5% Trimmed Mean	60.35	
		Median	57.95	
		Variance	364.320	
		Std. Deviation	19.087	
		Minimum	14	
		Maximum	100	
		Range	86	
		Interquartile Range	19	
		Skewness	.360	.414

Figure 5
N – gain test results for class VIII A (grade 1) and class VIII B (grade 2)

Based on Figure 5, the results show that the average value of class VIII A is 59.35 or 59.35%, including quite an effective category, with a minimum N-gain value of 14% and a maximum of 67%. When depicted through a graph, it can be presented in Figure 6 below.

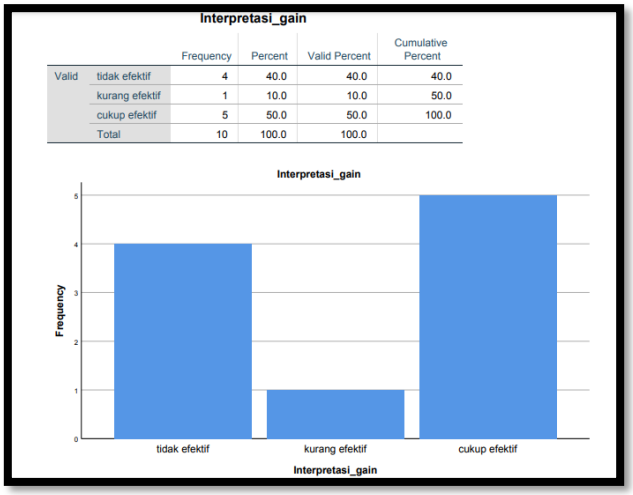

Figure 6
Graphic image of the effectiveness of class VIII A (Experimental class)

Based on Figure 5, the average value for class VIII B is 60.41 or 60.41% including the effective category, with a minimum N-gain value of 14% and a maximum of 100%. When depicted through a graph, it can be presented in Figure 7 below

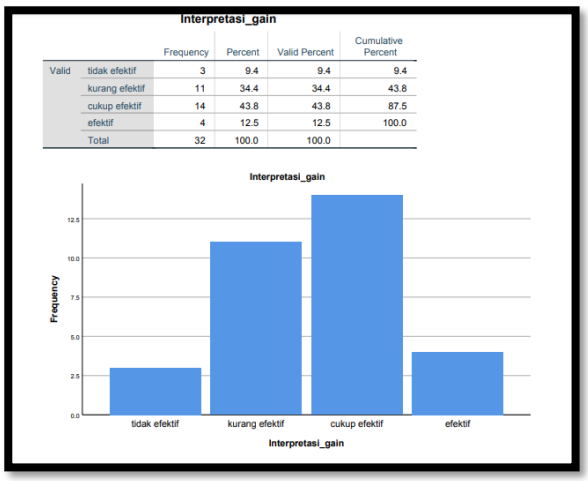

Figure 7
Graphic image of class VIII B (Control class) effectiveness

Based on Figures 6 and 7, there are differences in the validity values in the gain interpretation table. This is due to the difference in the number of different respondents in the Experiment class (10 respondents) and Control class (32 respondents) which causes differences in the number of validity (%) between the Experiment class and Control class.

Research on the use or development of e-modules based on STEM Project Based Learning has been investigated by several researchers, including (Agung et al., 2022), (Diani et al., 2021b), (Cahyani et al., 2020). The difference between this study and previous research is that this research focuses on the effectiveness of implementing the STEM Project Based Learning e-module on junior

high school statistics which discusses data distribution, average value, median, mode, and distribution of data to conclude, make decisions, and make predictions. The e-module contains exercises that help students think creatively and implement material on real-life projects and their relationship to STEM.

Conclusion

Based on the results of the study, it was found that E - Module Using STEM Project Based Learning is considered effective when applied in class VIII A and VIII B SMP N 1 Purwosari. This is based on the N – Gain test, the results show that the average value of class VIII A is 59, 35 or 59.35%, including quite an effective category, with a minimum N – gain value of 14% and a maximum of 67%. While the results of the average value for class VIII B is 60.41 or 60.41% including the effective category, with a minimum N-gain value of 14% and a maximum of 100%. Suggestions for teachers, namely E - Module STEM Project-Based Learning can be applied in learning in mathematics classes, especially in statistical material. Implementing the E-Module STEM Project-Based Learning can use a mobile phone or laptop, making it easier for students to learn this material anywhere and anytime. This E - module STEM project-based learning so its implementation requires student collaboration in completing project assignments. Suggestions for other researchers need further research to develop E-Module STEM Project - Based Learning on materials other than statistics, such as geometry, algebra, and others.

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