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Increasing Student Numeracy Ability Through Learning E-Module Statistics Integrated with Flipbook and Augmented Reality

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Abstract: This research was motivated by the low numeracy of students in statistics courses, which contradicts the importance of numeracy. For this reason, an integrated statistics e-module with a flipbook and augmented reality was developed with the aim that, through learning using this e-module, it can improve student numeracy. The use of flipbooks and augmented reality programs as an effort to integrate knowledge, pedagogy, and technology in an effort to improve numeracy. This research used quantitative methods, with the subjects being 58 students in statistics courses. The paired two-sample t-test technique was used to analyze the increase in numeracy through e-module learning. The data were analyzed with the help of the SPSS 21 for Windows program. The research results showed that there was an increase in student numeracy after using the e-module, with a significance value of 0.00 < 5% with t = -5.23> $-t_{0.05}$, so learning using the statistics e-module integrated with flipbooks and augmented reality can improve student numeracy.

Keywords: Numeracy; Integrated E-module, Statistic.

Peningkatan Kemampuan Numerasi Mahasiswa Melalui Pembelajaran E-Modul Statistika Terintegrasi Flipbook dan Augmented Reality

Abstrak: Penelitian ini dilatarbelakangi rendahnya numerasi mahasiswa pada mata kuliah statistika yang kontradiktif dengan pentingnya numerasi tersebut. Untuk itu dikembangkan e-modul statistika terintegrasi flipbook dan augmented reality dengan tujuan melalui pembelajaran menggunakan e-modul tersebut dapat meningkatkan numerasi mahasiswa. Penggunaan program flipbook dan augmented reality sebagai upaya pengintegrasian pengetahuan, pedagogik, dan teknologi dalam upaya meningkatkan kemampuan numerasi. Penelitian ini menggunakan metode kuantitatif dengan subjek adalah 58 mahasiswa pada mata kuliah statistika. Teknik uji-t dua sampel berpasangan digunakan untuk menganalisis peningkatan numerasi melalui pembelajaran e-modul. Data dianalisis dengan bantuan Program SPSS 21 for Windows. Hasil penelitian menunjukkan terjadi peningkatan kemampuan numerasi mahasiswa sesudah penggunaan e-modul dengan nilai signifikasi 0,00 < 5% dengan t hitung = -5,23> $-t_{0,05}$. Jadi pembelajaran dengan menggunakan e-modul statistika terintegrasi flipbook dan augmented reality dapat meningkatkan kemampuan numerasi mahasiswa.

Kata Kunci: Numerasi; E-modul terintegrasi; Statistika.

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INTRODUCTION

Numeracy achievement is based on the achievements of Indonesian students on the international stage, where Indonesian students' reading literacy ranks 72nd in 77 countries, 70% below the minimum competency. Followed by literacy skills in mathematics and science, which are 71% and 60% below the minimum competency (NCTM, 2003; OECD, 2017). Based on the achievements above, it can be seen that the ability to master numeracy is very important for students, including myself. However, the importance of numeracy literacy skills is contradictory to reality in the field. This can be seen in statistics lectures. In this lecture, it was identified that 78.38% of students can solve statistical problems using the SPSS.23 program; however, 86.21% of the students could not understand the symbols and numbers in the program output. Matter This indicates that students' numeracy abilities need to be analyzed further. One solution proposed is strengthening the ability to integrate information, draw conclusions, and generalize that knowledge to other things, thereby strengthening students' numeracy abilities (Pribowo et al., 2018; Purnama et al., 2023).

Strengthening such numeration can be supported by more media development paying attention to numeration in statistics lectures, namely flipbooks and augmented reality (AR) integrated e-modules. Integrated meaning is a form of innovation in the flipbook e-module media by inputting the SPSS.23 program, AR in the form of assembler.studio, and learning video QR-code. So, students have direct experience analyzing various types of symbols in different programs. The form of the statistics e-module is depicted in Figure 1.

Figure 1. Flipbook and AR-integrated statistics e-module

Related to the numeration to be analyzed, numeracy is defined as proficiency in using numbers and mathematical symbols to solve practical problems in everyday contexts (Santia et al., 2018). The Ministry of Education and Culture (2020) states that numeracy is knowledge and skills for using a variety of numbers and symbols related to basic mathematics to solve practical problems in everyday life and then analyzing information displayed in various forms as well as interpreting the analysis results to predict and make decisions. According to Pangesti (2018), numeracy consists of three aspects in the form of counting, numeration relations, and arithmetic operations. According to (Santia et al., 2019, 2021), numeracy is a cognitive level indicating the thought process required or necessary to be able to solve problems or questions. The cognitive process in numeracy is divided into three levels, namely: understanding, application, and reasoning (Ojose, 2011).

Regarding indicators for analyzing student numeracy, references are used for numeracy indicators based on the OECD and PISA (Ahyan et al., 2014; OECD, 2017). Mahmud&Pratiwi (2019) state that several indicators are used as a reference for measuring numeracy skills as contained in the OECD (Organization for Economic Co-operation and Development), including: (1) communication skills; (2) ability in mathematics; (3) representation ability; (4) reasoning and argumentation abilities; (5) ability to choose strategies to solve problems; (6) ability to use symbolic, formal, and technical languages and operations; (7) ability to use tools in mathematics.

Meanwhile, Santia (2017) stated indicators of numeracy ability according to PISA, which consists of six levels as follows: (1) at the first level, students are capable of answering questions with general context and all relevant information clearly available; (2) at the second level, students are able to interpret and recognize situations with contexts that require immediate conclusions, working out basic algorithms, using formulas, carrying out procedures, or agreeing to solve problems. Able to draw appropriate conclusions from the results of the solution; (3) at level 3, students are able to carry out procedures clearly, including those that require sequential decisions. Able to explain based on interpretation results and reasons; (4) at level 4, students are able to work using certain methods effectively in complex but concrete situations that may involve obstacles or make assumptions. Students are able to select and use different representations, including symbols; at level 5, students are able to develop and work with models for complex situations. Able to use thinking and reasoning and correctly link symbolic representations to situations faced. Able to describe and formulate the results of his work; and (6) at level 6, students are able to create concepts, generalize, and use information based on review and modeling in complex situations. He is able to formulate the results of his work appropriately by considering his discoveries, interpretations, opinions, and accuracy in real-life situations. Based on both indicator frameworks (OECD and PISA), indicators for student numeracy analysis on assignment statistics were developed showed in Table 1.

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METHOD

This research uses a comparative quantitative approach, namely research that compares initial test results and final test results after learning using an integrated statistics e-module with a flipbook and augmented reality. The subjects were 58 management study program students in statistics courses University of Nusantara PGRI Kediri. The sampling technique used is random sampling. The data analysis technique used in There are two types of research: descriptive and inferential analysis. Descriptive analysis is used to describe abilities in students' mathematics by giving questions based on statistics taken from the e-module, it can be seen in Figure 2.

This study aims to investigate differences between the number of seeds produced by each upper and lower flower of 10 mangrove plants. Is there any difference between the number of seeds produced by the upper and lower flowers of a plant?

	1	2	3	4	5	6	7	8	9	10
Upper	1,4	3,3	2,0	0,4	2,1	1,9	1,1	0,1	0,9	3,0
Lower	1,1	1,7	1,8	0,3	0,8	1,4	1,0	0,4	0,7	0,9

Figure 2. Statistical Problem

Next, the results of the subject's work are analyzed based on the numeracy indicators in Table 1. Then, to find out the student's numeracy level scores that have been categorized follow the guidelines in Table 2.

Table 1. Indicators of numerical literacy in statistical problem-solving

Level of Numeracy		Description
low	1	Students can: a) determine the information on the problem, and b) determine the research hypothesis
	2	Students can: a) determine the information on the problem, b) determine the research hypothesis, and c) Determine the significance level and the value of the t-table.
medium	3	Students can: a) determine the information on the problem, b) determine the research hypothesis, c) determine the significance level and the value of the t-table, and d) Determine the formula for the statistical test.
	4	Students can: a) determine the information on the problem, b) determine the research hypothesis, c) determine the significance level and the value of the t–table, d) determine the formula for the statistical test, and e) Determine the t-value calculated using the formula of the statistical test.
high	5	Students can: a) determine the information on the problem, b) determine the research hypothesis, c) determine the significance level and the value of the t-table, d) determine the formula for the statistical test, e) determine the t-value calculated using the formula of the statistical test, and f) Determine the rejection area of H_0.
	6	Students can: a) determine the information on the problem, b) determine the research hypothesis, c) determine the significance level and the value of the t–table, d) determine the formula for the statistical test, e) determine the t-value calculated using the formula of the statistical test, f) determine the rejection area of H_0, and g) Determine to accept or reject the research hypothesis.

Table 2. Student Numeracy Assessment Criteria

Score	Level
77 < Score ≤ 100	Non enough
36 < Score ≤ 77	Good Enough
0 < Score ≤ 36	Good

Source: data is processed (Santia, 2019)

Then inferential analysis was used to test prerequisite statistics and hypotheses. The test prerequisites used are the normality test and the hypothesis test, which is the t test with paired samples. (1) The normality test is used to find out whether the samples taken were normally distributed or not. (2) a-paired sample A t-test is used to find out if there is an increase in students' numeracy skills after using e-modules.

RESULT AND DISCUSSION

Based on the results of the data analysis The following research results were obtained:
1) Initial numeracy test results (pretest)

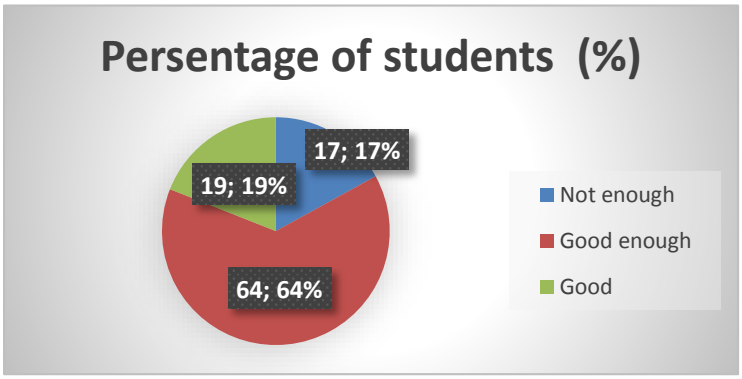

Figure 3. Pretest Result

From Figure 3, the percentage of students who have good numeracy skills is 19%; those who have sufficient numeracy are 64%; and those who have less numeracy ability are 17%. From the data, it is known that the number of students who have numeracy skills in solving problems during the pretest was quite greater than the number of students who have deep numeracy skills. I solved the problem while pretesting on good or bad criteria.
2) Final numeracy test results (posttest)

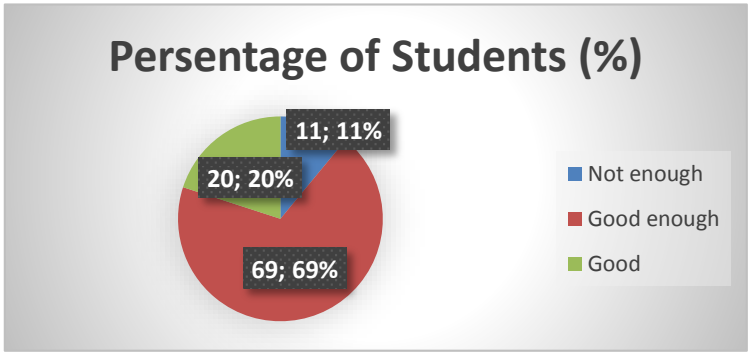

Figure 3. Posttest Result

From Figure 4, the percentage of students who have good numeracy skills is 20%, those with sufficient numeracy are 69%, and those with insufficient numeracy ability are 11%. From data It's known that the number of students who had numeracy skills in solving problems during the pretest was quite greater than the number of students who had numeracy abilities in solving problems during the posttest on the criteria of good or bad. But there has been an improvement in the percentage of numeracy ability in the good category by 1%, and the category is at 5%, so that means a decline in the ability category of low numeracy at 6%. It will be analyzed further and more in-depth to determine whether it really increased students' numeracy skills after using the e-module with test inference statistics paired with a t-sample. The first one The-normality of the pretest and posttest data will be checked.

3) Data Normality Analysis Results

As for calculating data normality pretest and posttest using Test Kolmorgorov-Smirnov normality and Shapiro-Wilk, the results are seen in Table 3. Based on the test in the Kolmogorov-Smirnov Z column for The pretest obtained a sig value of 0.118, and the posttest obtained a sig value of 0.057, which means a sig value > 0.05, then H0 is accepted and H1 is rejected, According to the Shapiro-Wilk test in SPSS, a significant level of α = 0.05 indicates a sig. pretest of 0.235, which means it is bigger than 0.05, so it can be concluded that the sample data comes from a population that is normally distributed.

Table 3. Normality Calculation Results Pretest Posttest Data with SPSS 21 for Windows.

Test of Normality						
	Komolgorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	Df	Sig.	Statistic	Df	Sig.
Pre-test	0.132	36	0.118	0.961	36	0.235
Post-test	0.144	36	0.057	0.947	36	0.087

a. Liliefors Significane Correction

Meanwhile, for the sig. posttest of 0.087, which means it is bigger than 0.05, it can be concluded that the sample data comes from the population, which is normally distributed.

4) Improvement Analysis Results: Numeracy After Using Flipbook and AR-integrated statistics e-module

Based on the test table above, we obtained a significance value of 0.00 < 5% with a calculated t = -5.23 > -0.05. So, it can be concluded that the use of e-modules can improve student numeracy. The results of the numeracy increase test above are in accordance with the statement by Wardani et al. (2011), who stated that Indonesian students need learning media that can strengthen their abilities to integrate information, draw interesting conclusions, and generalize knowledge they have about other things, not just procedural skills. The research results show that treatment with e-module learning can improve student numeracy ability, with the highest increase in the mathematization aspect.

Table 4. Paired Sample T-test

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	pretes - postes	-6,167	5,253	,959	-8,128	-4,205	-5,230	56	,000

Process capability indicators mathematization in the mathematization process horizontal, namely identifying concepts mathematics that are relevant to the real world, presenting problems in a variety of different ways, including organizing problems accordingly relevant mathematical concepts, formulating appropriate assumptions, and searching for the relationship between problems and symbols. formal mathematics so that problems are real and can be understood mathematically, Look for order, relationships, and patterns in related problems and translate the problem into mathematics, namely in the form of models (Biber, 2014; Santia et al., 2018; Angela et al., 2021).

Process capability indicators: vertical mathematization consisting of using a variety of different mathematical representations, using symbols, formal mathematical processes, making adjustments and developing mathematical models, combining and combining various models, mathematical arguments, and generalization (Sari et al., 2010; Rumiati, 2011; Supardi et al., 2019).

Learning by using the e-module always orients students to the problem. Lecturers always try to guide students, both individuals and groups, for Always study optimally; students keep pushing to present all the learning results with various forms and methods (multiple representations); students are always directed towards analyzing and evaluating the solving process of the problem. In the learning process e-module, students are also exposed to authentic and meaningful problems to carry out investigations and investigations, so that students can construct their own knowledge, develop skills higher, engage in inquiry, and become more confident and independent (Dwiranata et al., 2019; Megantari et al., 2021; Muhammad et al., 2023).

Advantages learning using integrated statistical e-modules with flipbooks and augmented reality is a contribution towards ability indicators such as numeracy. Those are the things that build students' numeracy skills through the use of e-modules. Another advantage of learning using this e-module is that students are looking for solutions to problems that are part of the importance of numeracy skills.

CONCLUSION AND RECOMMENDATION

The research results showed that there was an increase in student numeracy ability after using the e-module, with a significance value of 0.00 < 5% with t = -5.23> $-t_{0.05}$. So learning using the statistics e-module integrated with flipbooks and augmented reality can improve student numeracy. For further research, numeracy analysis can be developed with assessment aspects on different subjects and content.

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