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Analysis of the effectiveness of Competency Based Learning (CBL) model in improving numeration skills of students of SMA Negeri 1 Gending

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Abstract: *Mathematics education in Indonesia faces challenges in improving students' numeracy skills, particularly at the Senior High School (SMA) level. This study aims to analyze the effectiveness of the Competency-Based Learning (CBL) model in enhancing students' numeracy skills. The method used is an experimental approach with a quasi-experimental nonequivalent control group design. The sample consists of 60 grade XI students from SMA Negeri 1 Gending, divided into experimental and control groups. The research instruments include numeracy skill tests, observation sheets, and lesson plans (RPP). The normality test results indicate that the data are normally distributed, while the homogeneity test ensures uniformity between groups. The independent t-test reveals a significant difference between the experimental and control groups, with a t-value of 11.154 and $p < 0.05$. The experimental group applying the CBL model achieved a higher average score, with a mean difference of 13.100 and a 95% confidence interval (10.749–15.451). This study shows that the CBL model is more effective than conventional methods in enhancing students' numeracy skills. These findings are expected to serve as a reference for innovative mathematics teaching strategies to improve students' numeracy competencies.*

Keywords*: Competency-Based Learning, Numeracy Skills, Mathematics, Learning Effectiveness.*

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Introduction

Mathematics education in Indonesia faces great challenges in improving the quality of learning, especially in terms of students' numeracy skills. Numeracy skills, which include the ability to understand and use mathematics in a variety of contexts, is one of the key competencies that must be mastered by students at the senior high school (SMA) level. However, based on national evaluation results, many high school students still have difficulty in applying mathematical concepts in everyday situations. The low numeracy skills of students indicate that the learning methods used so far have not been effective in improving these competencies (Astutik, 2022). Therefore, it is necessary to innovate in learning models that can be more effective in improving students' numeracy skills..

One of the learning models that has been adapted in many countries is the Competency-Based Learning (CBL) model. This model focuses on achieving certain competencies measured through mastery of specific skills in a particular field, including mathematics (Saad et al., 2023). Skill-based learning encourages students to master each topic before moving on to the next, ensuring a deeper and more applicable understanding of the material learned. Research by (Sun & Xiao, 2023) shows that the use of a skills-based approach can improve student learning outcomes, especially in mathematics, as this model allows students to learn according to their own pace and ability.

In addition, skill-based learning models are often integrated with various strategies, including problem-based and collaborative learning, to encourage students to think critically and creatively. In this context, numeracy skills can develop through the application of mathematical concepts in real-world situations. This was proven in a study conducted by (Kholisunnada & Darmawati, 2023), who found that students who were taught using a skill-based learning model had a better ability to solve complex math problems compared to students who only followed conventional learning.

However, despite many studies that support the success of skill-based learning models in improving academic ability, especially in mathematics, the implementation of this model at the high school level in Indonesia is still relatively limited. Research by (Hasbiyallah et al., 2023) highlighted the lack of implementation of skill-based learning model in Indonesian schools, as well as the lack of training for teachers in adapting this model well in the local context. Therefore, this study aims to analyze the effectiveness of skill-based learning model in improving students' numeracy skills in high school.

In addition, although a number of studies have been conducted at the primary and tertiary education levels, research on the application of this model to high school students in Indonesia is still rare. Research by (Barnett & Jung, 2020) showed that the skill-based model can be applied effectively at the college level, but its application at the high school level has not been widely explored. For this reason, this study is very important to see how this model can be applied in learning mathematics in high school and how far the impact on students' numeracy skills.

Based on this background, the purpose of this study is to analyze the effectiveness of skill-based learning models in improving students' numeracy skills in high school. This research is expected to contribute to a deeper understanding of the application of skill-based learning models at the high school level, as well as provide insights for educators in choosing more effective methods to improve the quality of mathematics learning in Indonesia. Thus, this study also aims to suggest steps that can be taken by schools in implementing skill-based learning models more widely.

Method

This research uses a quantitative approach with experimental research. The design used was quasi-experimental design with nonequivalent control group design model. In this research, there are two groups, namely the experimental group applied with skill-based learning model and the control group taught with conventional learning methods. The population of this study were all students of grade XI of SMA Negeri 1 Gending. The research sample was taken by purposive sampling by considering homogeneous student characteristics, which consisted of two classes (experimental and control) with 30 students in each class.

The variables in this study consisted of two, namely the independent variable (x) in the form of a skill-based learning model, and the dependent variable (y) in the form of student numeracy skills measured through a learning outcome test. The instruments used in this study were a numeracy skills test consisting of multiple choice questions that had been tested for validity and reliability, as well as an observation sheet to monitor the learning process. The lesson plan (RPP) was also carefully prepared to ensure the suitability of the skill-based learning model used.

The research procedure was conducted in four stages. The first stage is preparation, which includes the preparation of research instruments, validation and reliability of tests, as well as the preparation of lesson plans in accordance with the skills-based learning model. The second stage was implementation, in which the experimental group was given learning with a skill-based learning model for six meetings, while the control group used conventional learning methods. Each meeting lasted for 90 minutes. The third stage is data collection through numeracy skill tests conducted after the learning is complete, as well as filling out observation sheets conducted by observers to see student interactions and activities during learning. The fourth stage is data analysis, which includes data prerequisite tests

such as normality test with Shapiro-Wilk because the data is <100 and homogeneity test with Levene. Furthermore, hypothesis testing was conducted using independent sample t-test to determine the significant difference between the learning outcomes of students taught using skill-based learning model and those using conventional methods.

Results and Discussion

Results

Before proceeding with further analysis, a normality test was conducted to ensure that the data distribution followed a normal distribution. This normality test uses the Shapiro-Wilk test, for each group tested (pretest and posttest in control and experimental classes). The results of the normality test can help determine whether the data meet the assumption of normal distribution, which is important for the continuation of the statistical test to be used.

Table 1. Data Normality Test

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Class	Statistic	df	Sig.	Statistic	df	Sig.
Results	Control Class Pretest	,133	30	,188	,963	30	,372
	Control Class Posttest	,137	30	,157	,934	30	,063
	Experiment Class Pretest	,086	30	,200*	,974	30	,656
	Experiment Class Posttest	,113	30	,200*	,972	30	,584

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

The results of the normality test using Shapiro-Wilk showed that the data in all groups (pretest and posttest for control and experimental classes) were normally distributed. For the Control Class Pretest, the p value was 0.372, for the Control Class Posttest the p value was 0.063, for the Experimental Class Pretest the p value was 0.656, and for the Experimental Class Posttest the p value was 0.584. All of these p values are greater than 0.05, which indicates that the data in each group is not significantly different from the normal distribution. Thus, the assumption of normality is acceptable, and further parametric statistical tests can proceed without concern for violations of the normality assumption.

After conducting a normality test which shows that the data in all groups are normally distributed, the next step is to conduct a homogeneity test to check whether the variances between groups are similar. This homogeneity test is important because some parametric statistical tests, such as the Independent Samples t-test, assume that the variances between the groups being compared are homogeneous (the same). Therefore, Levene's Test was conducted to check the similarity of variance between groups. The following normality test results are shown in Table 2.

Table 2. Data Homogeneity Test

Test of Homogeneity of Variances

Results			
Levene Statistic	$df1$	$df2$	Sig.
,036	1	58	,850

The results of Levene's Test for Homogeneity of Variances show a Levene Statistic value of 0.036 with df1 = 1 and df2 = 58, and a p-value of 0.850. Because the p-value > 0.05, it can be said that the variance between groups is homogeneous (the same). Thus, it can be concluded that the variance between the control and experimental groups is not significantly different, which means that the assumption of homogeneity of variance is met. Therefore, further statistical tests, namely the Independent Samples t-test, can be carried out with the assumption of homogeneous variance.

Table 3. Independent Samples t-test

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	*df*	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Results	Equal variances assumed	3,532	,065	11,154	58	,000	13,100	1,174	15,451	10,749
	Equal variances not assumed			11,154	52,747	,000	13,100	1,174	15,456	10,744

The results of the Independent Samples t-test to analyze the significant differences between students taught using the Competency-Based Learning (CBL) model and students taught with conventional methods show highly significant results. Based on Levene's Test for Equality of Variances, the p value of 0.065 indicates that the variance between groups is considered homogeneous (because p> 0.05), which means we can use the t-test results assuming equal variances assumed. The t-test results show a t-value of 11.154 with df = 58 and a p-value of 0.000, which is smaller than 0.05, so the difference between the two groups is highly significant.

The Mean Difference value of 13.100 indicates that the mean results between the two groups are different, with the group treated with the Competency-Based Learning (CBL) model having a higher mean score. The 95% confidence interval for the mean difference between the two groups ranges from 10.749 to 15.451, which does not include a value of zero, reinforcing the conclusion that the difference between the two groups is significant. Thus, it can be concluded that there is a significant difference in the results achieved between the two groups tested.

Discussion

The results of this study indicate that the Competency-Based Learning (CBL) model has a significant effect on improving the numeracy skills of SMA Negeri 1 Gending students compared to the conventional method. Based on the results of the Independent Samples t-test, there is a very significant difference between students taught using the CBL model and students taught with conventional methods, with a p value of 0.000 (smaller than 0.05). This indicates that the CBL model provides better results in improving students' numeracy skills.

The importance of competency-based teaching (CBL) in learning mathematics, especially numeracy, lies in an approach that is more focused on mastering concrete and measurable skills, which encourages students to be more active in the learning process. The CBL model emphasizes learning that is tailored to the level of students' abilities, provides opportunities to learn at the pace of each individual, and allows the application of knowledge in a context that is more real and relevant to students' daily lives. In this study, the Mean Difference of 13.100 shows that students taught with the CBL model obtained a higher average score, indicating that this approach is more effective than the conventional method which is more passive and structured.

This research is in line with a number of previous studies that show that competency-based learning models have a positive impact on improving numeracy skills and understanding of mathematical concepts. For example, a study by (Alghadari et al., 2020) showed that the application of CBL in mathematics education at the high school level can improve students' understanding of the material taught and the ability to apply mathematical concepts in more complex situations. The results of (Alghadari et al., 2020) showed that students who experienced competency-based learning were better able to solve numerical problems in a more creative and analytical way compared to students who followed conventional learning.

In addition, (Kytmanov et al., 2016) in his research on competency-based learning in mathematics education also found that this model allows students to develop numeracy skills in a more structured way and provides more intensive feedback, which helps students in identifying their strengths and weaknesses in mastering the material. This may explain why the average student results in this study were higher after the CBL model was applied.

On the other hand, research by (Merritt, 2015) found that while conventional methods still have their place in education, models that emphasize practical and applicable skills, such as CBL, tend to be more effective in the context of numeracy skills learning, which prioritizes knowledge application over rote memorization or standardized procedures.

Conclusion

This study shows that the Competency-Based Learning (CBL) model is more effective in improving the numeracy skills of SMA Negeri 1 Gending students compared to the conventional method. The Independent Samples t-test results showed a significant difference between the two groups, with a t-value = 11.154 and p-value = 0.000 ($p < 0.05$). The Mean Difference of 13.100 indicated the CBL group had a higher mean score. The 95% confidence interval for the mean difference ranges from 10.749 to 15.451, which strengthens the conclusion that the CBL model is more effective in improving students' numeracy skills.

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