Thinking Skills and Creativity Journal
Volume 7, Number 1, Tahun 2024, pp. 175-181
P-ISSN: 2615-4692 E-ISSN: 2615-6105
Open Access: https://doi.org/10.23887/tscj.v7i1.78228

Contextual-based Open-Ended Model Improves Numeracy Skills of Grade IV Elementary School Students

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ARTICLE INFO

Article history:
Received January 08, 2024
Accepted March 10, 2024
Available online April 25, 2024

Kata Kunci:
Open-Ended, *Kontekstual, Kemampuan Numerasi Siswa*

Keywords:
Open-Ended, Contextual, Students' Numeracy Ability

ABSTRAK

Penelitian ini dilatarbelakangi oleh permasalahan numerasi yang ada di sekolah dasar. Peserta didik cenderung lebih pasif dalam pembelajaran matematika dikarenakan peserta didik kesulitan untuk mengungkapkan argumen dan ide matematis. Kurangnya inovasi dalam proses pembelajaran membuat siswa menjadi bosan saat belajar. Maka dari itu diperlukan model pembelajaran yang sesuai. Penelitian ini bertujuan untuk mengetahui pengaruh model pembelajaran Open-Ended berbasis Kontekstual terhadap kemampuan numerasi siswa kelas IV sekolah dasar. Jenis penelitian yang digunakan adalah penelitian eksperimen semu (quasy experiment) dengan jenis Nonequivalent Control Group Design. Populasi dalam penelitian ini adalah seluruh kelas IV sekolah dasar yang terdiri atas 9 kelas dengan jumlah siswa 214 orang. Teknik penentuan sampel dalam penelitian ini adalah teknik cluster random sampling sehingga diperoleh sampel dalam penelitian ini adalah sebanyak 28 orang sebagai kelompok eksperimen dan sebanyak 26 orang sebagai kelompok kontrol. Data kemampuan numerasi diperoleh dengan memberikan instrumen berupa tes objektif bentuk pilihan ganda biasa. Data kemampuan numerasi siswa dianalisis dengan uji-t Polled Varians. Hasil analisis menunjukkan bahwa terdapat perbedaan yang signifikan antara kelompok eksperimen dan kelompok kontrol. Dengan demikian, dapat disimpulkan bahwa model Open-Ended berbasis Kontekstual berpengaruh terhadap kemampuan numerasi siswa kelas IV sekolah dasar. Model Open-Ended berbasis Kontekstual tidak hanya memberikan masalah terbuka yang berkaitan dengan situasi nyata kepada siswa tetapi juga dapat menjamin keterbukaan aktivitas siswa dalam proses pembelajarannya.

ABSTRACT

This research is motivated by numeracy problems that exist in elementary schools. Students tend to be more passive in learning mathematics because students have difficulty expressing mathematical arguments and ideas. Lack of innovation in the learning process makes students bored while studying. Therefore, an appropriate learning model is needed. This research aims to determine the effect of the contextual-based Open-Ended learning model on the numeracy abilities of fourth grade elementary school students. The type of research used is quasi-experimental research with the Nonequivalent Control Group Design type. The population in this study was all class IV elementary schools consisting of 9 classes with a total of 214 students. The sampling technique in this study was a cluster random sampling technique so that the sample obtained in this study was 28 people as the experimental group and 26 people as the control group. Numeracy ability data was obtained by administering an instrument in the form of an objective test in the form of a regular multiple choice. Student numeracy ability data was analyzed using the Polled Variance t-test. The results of the analysis show that there are significant differences between the experimental group and the control group. Thus, it can be concluded that the contextual-based Open-Ended model has an influence on the numeracy abilities of fourth grade elementary school students. The Contextual-based Open-Ended Model not only provides students with open problems related to real situations but can also guarantee openness to student activities in the learning process

1. INTRODUCTION

The importance of numeracy skills in 21st century learning is not in line with the numeracy skills of students in Indonesia (Widiastuti et al., 2022; Dewi et al., 2021). This was found from several previous

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studies which showed that students' numeracy abilities were still in the low category (Ate & Lede, 2022; Mahmud & Pratiwi, 2019). One of the factors causing the low numeracy skills of students in Indonesia is because students are not yet accustomed to solving real-life problems and are not yet able to analyze information in various forms (Aisah, Zaqiah, & Supiana, 2021; Ambarwati & Kurniasih, 2021). The numeracy abilities of students in Indonesia are also still below the international average.

This information is also supported by observations and interviews that have been conducted in Cluster VIII Mengwi. Cluster VIII Mengwi consists of 7 elementary schools, namely Elementary School No. 1 Mengwi, Elementary School No. 2 Mengwi, Elementary School No. 3 Mengwi, Elementary School No. 4 Mengwi, Elementary School No. 1 Werdhi Bhuana, Elementary School No. 2 Werdhi Bhuana, and Elementary School No. 3 Werdhi Bhuana. Based on school education report data in Cluster VIII Mengwi, numeracy skills in all schools are still below the minimum competency or less than 50%. Based on interviews with grade IV homeroom teachers, information was obtained that students tend to be more passive in mathematics learning because students have difficulty expressing mathematical arguments and ideas.

The interview results also showed that students were less able to understand and lacked the ability to solve contextual problems in mathematics learning. In addition, students still often make mistakes and errors when performing mathematical calculations. Numeracy skills are needed in all aspects of life. Decisions in everyday life also require proper numeracy skills. Numeracy skills have a significant impact on students, society, and the nation and state in the context of 21st century learning (Ulfa et al., 2022; Swandewi et al., 2019).

As teachers in elementary schools, you should strive for students to actively participate in learning activities and be able to train students to analyze information in numerical form to improve students' numeracy skills. Teachers' efforts to improve students' numeracy skills certainly require innovative and effective learning by implementing appropriate learning models (Nurcahyono, 2023; Isrok'atun & A. Rosmala, 2021). One alternative solution that can be used to overcome the problem of low student numeracy skills is by using contextual learning.

Contextual is learning that can be used in education that links learning materials with real-world situations experienced or known to students (Nengsi et al., 2021; Abi, 2017). Learning in this way can provide a more meaningful learning experience for students, because they have experienced it in everyday life. Apart from contextual learning, there is also an open-ended problem model which has also been proven to be effective in the learning process.

The open-ended model can provide students with the freedom to explore various ways to solve mathematical problems (Andiani et al., 2021; Dewi et al., 2021). The open-ended model was chosen because it is able to invite students to better understand a contextual-based Mathematics problem. Students can collaborate in teams or independently, so that students can find new information needed in solving everyday problems. Open-ended learning allows students to answer and solve problems in various ways, allowing for many correct answers (Lestari et al., 2019; Nissa t al., 2019).

Through the open-ended learning model, students are given the opportunity and freedom to explore various ways that are certain so that they can spur the development of students' numeracy skills. Several previous studies have shown that the open-ended model has been proven to have an effect on improving students' Mathematics learning outcomes (Kume et al., 2023; Hanifah et al., 2019). Based on the results of the study, it is known that the application of the open-ended learning model has been proven to improve students' mathematics learning outcomes. Previous studies have discussed the use of the open-ended model to assess mathematics learning outcomes. Meanwhile, the current study discusses the influence of the contextual-based open-ended model on the numeracy skills of grade IV elementary school students.

Based on the description that has been presented, of course learning related to numeracy skills is very important to do. Therefore, this study aims to determine the effect of the contextual-based open-ended learning model on the numeracy skills of grade IV elementary school students. Innovation in the use of contextual-based open-ended learning modelIt is hoped that it can improve students' numeracy skills. By using this learning model, it is hoped that students can more easily understand the material taught by the teacher.

2. METHOD

This study used a quasi-experimental research design with a nonequivalent control group design. This study consisted of three stages, namely the preparation stage, the implementation stage, and the final stage of the study. The population in this study were all grade IV in Gugus VIII Mengwi for the 2023/2024 Academic Year consisting of 9 classes with a total of 214 students. After knowing the population, the next step was to determine the research sample using cluster random sampling. Based on the lottery, the results showed that grade IV of SD No. 4 Mengwi was the experimental class and grade IV A of SD No. 1 Mengwi was the control class.

The data collection method and instrument used in this study is a test. The test method used to collect data in this study is a multiple-choice test with data in the form of scores or quantitative data on a scale of 100. The data collected in this study is data on students' numeracy abilities. Preparing a grid is the first step that must be taken every time a test is prepared and questions are made. The test grid is used to facilitate testing the validity of the test content to be more systematic. The grid used in this study can be presented in Table 1.

Table 1. The Research Instrument Grid

Numeracy	Numeracy Indicator	Question Indicator
Numeracy is the ability to think using mathematical concepts, facts, and tools to solve everyday problems in various types of contexts that are relevant to individuals as citizens of Indonesia and the world. Numeracy includes the skills of applying mathematical concepts and rules in real situations.	Using a variety of numbers and symbols related to basic mathematics to solve problems in a variety of everyday life contexts.	Determine the results of the arithmetic operations presented in story problems. Analyze solutions to solve problems in everyday life related to arithmetic operations.
	Analyze information displayed in various forms (graphs, tables, charts, diagrams, etc.).	Analyze information in various forms regarding problems in everyday life.
	Interpret analysis results to predict and make decisions.	Interpreting the truth or conclusions in information regarding solutions to everyday problems.

Source : Han et al., (2017) with modification

Before the test instrument is distributed, a trial of the instrument is generally carried out first to determine whether each question item has met the criteria for a good question and is suitable for use or still needs improvement. Testing of students' numeracy ability instruments is carried out through several tests, namely validity tests, reliability tests, difficulty indexes, and discriminatory power. After making the instrument, a content validity test is carried out. The content validity test is carried out on the numeracy ability test instrument. This validity test is carried out with the Gregory validity test based on the assessment of two experts.

In this study, the data analysis techniques used are descriptive statistical analysis techniques and inferential statistics. Descriptive statistics are statistics used to analyze data by describing or depicting data that has been collected as it is without intending to make conclusions that apply to the public or generalization. Some ways that can be used to describe, depict, explain, or describe data include determining the size of the data such as the average value (mean). Meanwhile, inferential statistical analysis is a technique for testing research hypotheses by applying inferential statistical formulas and then drawing conclusions based on the results of testing the hypothesis. The data tested in inferential statistical analysis is post-test data, so it is tested using the t-test technique. Before carrying out the t-test, prerequisite tests are first carried out in the form of normality tests and homogeneity tests.

3. RESULT AND DISCUSSION

Result

The data from this study consist of 2 groups, namely (1) data on the numeracy skills of fourth grade students who were taught using the contextual-based open-ended model (experimental group data) and (2) data on the numeracy skills of fourth grade students who were not taught using the contextual-based open-ended model (control group data). The data that has been collected is then analyzed according to the data analysis techniques that have been previously determined.

The experimental group in this study were 28 fourth grade students of SD No. 4 Mengwi. The experimental group was given a pre-test and continued with treatment with an open-ended contextual model six times. Then, at the end of the study, students were given a post-test. Based on the data obtained, it is known that the highest post-test score in the experimental group was 95 and the lowest score was 60. The average post-test score of the experimental group was 81.43. The standard deviation is 9.01, with a diversity of values of 81.22. Furthermore, the average (mean) of the numeracy ability scores of the experimental group students can be categorized by converting them to a PAP scale of 5. From these results, the mean percentage of the experimental group students' numeracy ability was 81.43% and was in the high category.

The control group in this study were 26 students of class IV A at SD No. 1 Mengwi. The control group was given a pre-test and continued with treatment with a model commonly used by teachers other than the contextual-based open-ended model six times. Then, students were given a post-test at the end of the study.

Based on the data obtained, it is known that the highest post-test score in the control group was 90 and the lowest score was 55. The average post-test score of the control group was 69.81. The standard deviation is 10.81, with a diversity of values of 116.96.

Furthermore, the average (mean) of the numeracy ability scores of the control group students can be categorized by converting them to the PAP scale of 5. Based on these results, the mean percentage of the experimental group students' numeracy ability was 69.81% and was in the moderate category. Before testing the hypothesis, an assumption test was carried out according to the inferential statistics used. In this study, the hypothesis test was carried out using the Polled Variance t-test or analysis of the average of two unpaired groups which required the fulfillment of the normality of the data distribution and the homogeneity of the variance of the two groups. The following describes the results of the normality test of the data distribution and the homogeneity test of the variance on the numeracy ability data of grade IV students in the sample group.

The normality test of the distribution of numeracy ability data of the control group students was carried out using the Shapiro-Wilk test at a significance level of 5%. Decision making is based on the provision that if the p_{value}> 5% then the data is normally distributed, but if the p_{value} ≤ 5% then the data is not normally distributed. Based on the results of the calculation of the data normality test work table with the Shapiro-Wilk test, the T3 value was obtained, namely 0.932 and the Shapiro-Wilk table value with n as many as 26 was 0.920. The T3 value is greater than the Shapiro-Wilk table value, which is 0.932> 0.920. Thus, it can be concluded that the numeracy ability data of the control group students has followed the normal data distribution.

The homogeneity of variance test was conducted to determine the differences that occurred in the hypothesis test caused by the variance between groups, not as a result of differences within the groups. The data homogeneity test used in this study was the F test (Fisher). Based on the results of the calculation of the homogeneity of variance test, the F_{count} value of the post-test results of the experimental and control groups was 1.44 while the F_{table} of the two groups with a significance level of 5% with db numerator = 25 and db denominator = 27 was 2.18. It is known that F_{count} is smaller than F_{table}, which is 1.44 <2.18. Thus, the variance of the numeracy ability data of students in the experimental and control groups is declared homogeneous.

Based on the results of the analysis prerequisite test, it is known that the data obtained from the sample group has been distributed normally and homogeneously. Therefore, the data has met the prerequisite test, so that a hypothesis test can be carried out using the Polled Variance t-test. The recapitulation of the t-test results of the post-test of students' numeracy abilities in the experimental and control groups can be presented in Table 2.

Table 2. t-Test Recapitulation

Research Group	Many Students	$\overline{X}$	S2	Degrees of Freedom (df)	t-count	t-table
Experimental Group (SD No. 4 Mengwi)	28 students	81.43	81.22	52	4.30	2.00665
Control Group (SD No. 1 Mengwi)	26 students	69.81	116.96			

Based on Table 2, it can be seen that t_{count} = 4.30 and at a significance level of 5% with dk = 52, t_{table} = 2.00665 is obtained. It is known that t_{count} is greater than t_{table}, 4.30 > 2.00665. Thus, it can be concluded that H_0 which states that there is no significant difference in numeracy ability between the group of students who are taught with the contextual-based Open-Ended model and the group of students who are not taught with the contextual-based Open-Ended model in class IV Cluster VIII Mengwi is rejected and H_a which states that there is a significant difference in numeracy ability between the group of students who are taught with the contextual-based Open-Ended model and the group of students who are not taught using the contextual-based Open-Ended model in class IV Cluster VIII Mengwi is accepted.

These results indicate that there is a significant difference in numeracy ability between the group of students who were taught using the Contextual-based Open-Ended model and the group of students who were not taught using the Contextual-based Open-Ended model in class IV Cluster VIII Mengwi.

Discussion

This research was conducted in class IV Gugus VIII Mengwi, especially in class IV SD No. 4 Mengwi as an experimental group with 28 students and class IV A SD No. 1 Mengwi as a control group with 26 students. The experimental group used a contextual-based open-ended learning model, while the control group used a learning model commonly used by teachers other than the contextual-based open-ended model.

Based on the acquisition of numeracy skills in both groups, it can be seen that the two groups that initially had equal abilities, after being given different treatments. The numeracy skills of students in the experimental group were better when compared to the numeracy skills of students in the control group. Judging from the analysis of students' numeracy skills data with descriptive analysis, there is a difference in the average numeracy skills of students between the group that was taught with the contextual-based open-ended model and the group that was not taught with the contextual-based open-ended model.

This is because learning with an open-ended model based on contextual can encourage students to learn with open problems that present contextual problems with various ways of solving and the solutions are also diverse. These factors can develop students' critical thinking and creative thinking skills, so that by providing various answers to existing problems, students' numeracy skills also progress. With these activities, learning can be made more meaningful and not just memorization for students.

This is in line with previous research which states that the open-ended model can make students participate more actively in learning and be better able to solve various mathematical problems according to the reasoning abilities possessed by the students (Ratau, 2016; Setiawan & Harta, 2014). The differences that emerged between the experimental class and the control class were caused by the application of the Contextual-based Open-Ended learning model applied in learning in the experimental class.

When learning in the experimental group class, students do more learning activities independently and in groups. These activities help students participate more actively in learning. Thus, students can formulate and try various problem-solving techniques that are carried out independently or in groups based on their understanding. Meanwhile, the teacher acts as a facilitator by providing direction and guidance to students to help the learning process occur.

The open-ended learning model can make students participate more actively in learning and often express their ideas (Lestari et al., 2017; Biliya, 2015). Open-ended also gives students more opportunities to utilize their mathematical knowledge and skills comprehensively. Students with low mathematical abilities can respond to problems in their own way. In addition, students are intrinsically motivated to provide evidence or explanations. No less important, open-ended learning gives students a lot of experience to find something in answering problems (Herdiman, 2017; Rudyanto, 2016).

Based on the results of observations during the implementation of the contextual-based open-ended learning model, students in the experimental class began learning by listening to the teacher's explanation of learning objectives. Furthermore, the teacher will present an open-ended problem related to everyday life situations (contextual). Thus, the problem will have many solutions and many answers. Furthermore, students will have discussions and fill in the LKPD distributed by the teacher.

During the discussion, students will work together with their groups to find various solutions to problems and of course each group has different techniques and answers based on the mindset and creativity of each group. When students discuss, the teacher supervises and accompanies each group in solving problems and guides groups that are having difficulties. After discussing and completing the problem solving on the LKPD, representatives of each group present the results of their group discussions. The presentation activity is then continued with different answers from each group.

In this case, the teacher plays an important role in correcting possible misunderstandings and students together with the teacher make a conclusion to produce more than one correct answer from the various techniques that have been used. Through the application of the contextual-based open-ended model, students become more active in classroom learning, thus fostering critical and creative student thinking patterns when looking for ideas to find solutions to problems. This model also causes students to discuss more and exchange ideas with their group members in finding various or more than one answer to open problems related to real life.

This is in line with previous research which revealed that open-ended is effective for use in Mathematics learning because it can develop students' critical thinking skills and increase student involvement in the learning process (Rohmah & Ulya, 2021; Angkasa et al., 2019; Nugroho, 2017). In the application of this contextual-based open-ended model, it can be said that from the results of the research conducted, this model has an influence on the numeracy skills of elementary school students.

Meanwhile, in the control group, learning activities implemented learning models commonly used by teachers or models other than open-ended based on contextual. In its application, the model used by teachers in the control class tended to be less than optimal. Learning activities were carried out by the teacher explaining a number of materials to students then interspersed with a few questions and answers and then continued with giving individual assignments. Students also still depended on explanations from the teacher, so the teacher did more activities than the students during class learning.

Teacher-focused learning makes students have less opportunity to develop thinking skills, opportunities to work together in groups, and solve problems encountered in everyday life. Learning with traditional models or methods can make students quickly bored and less enthusiastic in learning. This is in line with the results of previous studies which state that conventional learning makes students feel bored (Hidayat et al., 2020; Wungguli & Yahya, 2020; Juniantari & Kusmariyatni, 2019; Hakim & Syofyan, 2017).

Therefore, teachers should be able to vary learning in order to create a pleasant learning atmosphere, so as to be able to create quality students and help them find their potential well. Because in essence, education should help humans in finding their potential (Kusadi et al., 2020; Wardani & Sulistya, 2020).

Based on the results of the study, it is known that the novelty in the use of contextual-based open-ended models has an influence on the numeracy skills of grade IV elementary school students. Contextual-based open-ended models can help students develop their ideas in solving open problems related to real life independently or in groups. Therefore, this study has implications for active student involvement in learning and improving students' numeracy skills. The limitation of this study is that the scope of application of the learning model is only carried out in one school. In addition, this study was also unable to overcome all the problems in the school. Further research can choose a wider scope of research and provide solutions to broader problems in elementary schools.

4. CONCLUSION

Based on the research conducted, it can be concluded that the contextual-based open-ended model has an influence on the numeracy abilities of fourth grade students in Cluster VIII Mengwi. The novelty in the use of contextual-based open-ended models has been proven to provide good contributions if applied appropriately to Mathematics learning in elementary schools.

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