



# Problem Based Learning Model with the TPACK Approach in the Numeracy Ability of Fifth Grade Elementary School Students

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## ABSTRAK

Hasil PISA 2018, Data Rapor Pendidikan Indonesia dan Nilai AKM menunjukkan bahwa kemampuan numerasi siswa kelas V sekolah dasar di Indonesia masih sangat rendah. Salah satu faktor penyebabnya adalah dominasi penggunaan metode ceramah dalam proses pembelajaran. Tujuan penelitian ini yaitu untuk menganalisis Model Problem Based Learning dengan Pendekatan TPACK dalam Kemampuan Numerasi Siswa kelas V Sekolah Dasar. Penelitian ini merupakan penelitian eksperimen dengan desain Nonequivalent Pretest Posttest Control Group Design. Penelitian ini dilakukan kepada siswa kelas V sekolah dasar yang dibagi menjadi kelompok eksperimen dan kelompok kontrol yang ditentukan dengan Teknik Cluster Random Sampling. Data dari penelitian ini dikumpulkan dengan metode tes menggunakan instrumen tes kemampuan numerasi. Data dianalisis dengan uji T Polled Varians karena memiliki varians data yang homogen. Hasil penelitian ini diketahui terdapat perbedaan yang signifikan kemampuan numerasi pada siswa yang dibelajarkan dengan model Problem Based Learning dengan Pendekatan TPACK dan pada siswa yang tidak dibelajarkan dengan model tersebut. Model Problem Based Learning dengan pendekatan TPACK dapat digunakan pada proses pembelajaran khususnya pembelajaran numerasi karena model ini dapat mendorong siswa belajar secara mandiri sehingga siswa dapat menemukan dan memahami konsep melalui dirinya sendiri.

## ABSTRACT

The 2018 PISA results, Indonesian Education Report Card Data, and AKM Scores show that the numeracy skills of fifth-grade elementary school students in Indonesia still need to improve. One of the contributing factors is the dominance of the use of the lecture method in the learning process. This research analyzes the Problem-Based Learning Model with the TPACK Approach in the Numeracy Ability of Class V Elementary School Students. This research is an experimental research with a Nonequivalent Pretest post-test control Group Design. This research was conducted on fifth-grade elementary school students who were divided into an experimental group and a control group determined using the Cluster Random Sampling Technique. Data from this research was collected using a test method using a numeracy ability test instrument. Data were analyzed using the Polled Variance T-test because it has a homogeneous data variance. The results of this research show a significant difference in numeracy abilities in students who are taught using the Problem-Based Learning model with the TPACK Approach and in students who are not taught using this model. The Problem-Based Learning model with the TPACK approach can be used in the learning process, especially numeracy learning because this model can encourage students to learn independently so that students can discover and understand concepts through themselves.

## 1. INTRODUCTION

Learning based on the 2013 Curriculum is identical to learning based on a scientific approach with a choice of learning models in the form of Problem Based Learning, Project Based Learning, Discovery Learning and Inquiry Learning (Haqiqi, 2019; Rahmah et al., 2022). Learning is also designed to be student-centered or called student-centered. Its implementation at the basic education level has the main

characteristic, namely integrated thematic learning which links learning material with conditions in everyday life (contextual learning) (Ardian & Munadi, 2015; Yusnita & Muqowim, 2020). This learning design is expected to make students have the ability and skills to solve everyday problems based on the theories they have studied at school and students are expected to have good literacy and numeracy skills. Numeracy ability is the ability to analyze, provide reasons, communicate effectively about solutions to mathematical problems in various situations encountered in everyday life. (Akca et al., 2022; Sari et al., 2021). Numeracy ability is the ability to understand and react critically to quantitative and statistical information relating to social, economic and environmental problems and how data is presented in accordance with public regulations. (Akca et al., 2022; Muhyidin et al., 2018a). Numeracy ability is an important ability for a child to have for success in working as an adult. Failure to develop these abilities can cause obstacles in learning mathematics and then lead to greater difficulties in the future. Having numeracy skills is fundamental for every student to be able to master other abilities. Numeracy skills are a very important ability to have because if not, it will have a bad impact on a person's psychology and social life. (Rakhmawati & Mustadi, 2022; Saal et al., 2018).

The actual situation in the field has apparently not been able to meet learning expectations based on the 2013 Curriculum. The literacy and numeracy abilities of students in Indonesia are low when compared to the literacy and numeracy abilities of students in the world. (Hanik, 2020; Nurwahidah, 2017).. The low numeracy ability of students in Indonesia shows that there are problems in implementing the learning process so that students are not able to learn optimally. There are many factors that influence the implementation of the learning process, including teachers, students, schools, facilities and infrastructure, and the government. One of these factors is the choice of methods in teaching and learning activities. The conventional teaching method or lecture method is a teaching method that is very popular among teachers in Indonesia. As many as 90.9% of teachers in Pariaman Regency still use the lecture method for teaching. (Helmi, 2016; Muhyidin et al., 2018b). There are 12 main reasons why teachers use the lecture method, namely making it easier to control the class, effective in busy classes, easy to plan and carry out, saving time, not mastering other methods, being able to clarify material descriptions, being able to improve student learning outcomes, not mastering technology, easy understood by students, more communicative, can see direct feedback from students, and is easy to combine with other methods (Ni'mah & Dwijananti, 2014; Wicaksana & Sanjaya, 2022).

The lecture method does not provide opportunities for students to explore learning and discover for themselves the important information in the lesson because all the material has been explained directly by the teacher. The lecture method tends to make students memorize all the material provided without understanding the basic concepts of the material being studied so that learning becomes less meaningful. Learning that lacks meaning has an impact on students' low abilities, especially in the fields of literacy, numeracy and science. Thus, a solution is needed so that teachers can design meaningful learning that is able to encourage students to actively participate in learning so that learning can be carried out optimally and can improve students' abilities, especially their numeracy abilities. One learning model that can help students be active in learning is the Problem Based Learning Model with the TPACK Approach (Kasuga et al., 2022; Suari, 2018). Several studies state that the Problem Based Learning model applied to students is able to improve student learning outcomes. Similar research states that the influence of the problem based learning model on learning outcomes shows that problem based learning can effectively improve learning outcomes (Ariyani & Kristin, 2021; Nafiah & Suyanto, 2014). This is similar to saying that the influence of the Problem Based Learning Model on Student Learning Outcomes also shows that learning with Problem Based Learning can improve learning outcomes. The influence of the Problem Based Learning Model on Student Achievement, especially in the field of Economics, namely that this model can improve student achievement because this model uses problems as initial material to be discussed in class. Apart from that, by using this model, the teacher has prepared a thorough learning plan so that it can be used in class well. The Problem Based Learning model is effectively used to improve students' problem solving abilities because in the learning process students go through several stages such as finding and analyzing problems, looking for solutions, making predictions and drawing conclusions from solutions that have been found to solve problems. (Djononiarjo, 2020; Nafiah & Suyanto, 2014).

Based on the description above, it can be seen that using the Problem Based Learning model in learning is able to encourage students to gain direct experience to find information, problems and solutions to solve problems related to numeracy. Through this activity, it encourages students to better understand the concept of the material rather than processing all the material by memorizing it. Understanding the concept of numeracy material correctly will help students improve their numeracy skills. Problem Based Learning is a learning model that builds a learning atmosphere when problems become the core of learning activities. Learning will begin with a problem that must be resolved or resolved (Ariyani & Kristin, 2021; Nafiah & Suyanto, 2014). In Problem Based Learning, students are encouraged to conduct research,

connecting theory in books and practice in the field, using knowledge and skills to develop a sustainable solution to solve a problem. Problem Based Learning is an alternative learning model that is good for improving students' academic achievement because this model introduces problems to start learning (Argaw et al., 2017; Ariyani & Kristin, 2021). Problem Based Learning is a learning model developed from constructivism theory that encourages students to understand learning concepts better. This model bridges groups of students to collaborate in finding solutions and developing scientific concepts and also improves students' communication skills (Argaw et al., 2017; Wenno & Batlolona, 2021). TPACK is a combination of 3 main components (technology, pedagogy, and content) in learning. In its application, the use of TPACK in the classroom requires effective use of technology, an understanding of concept representation with technology and pedagogical techniques that use constructive technology to teach lesson content (material) to students. (Nurmansyah, 2020; Sitompul et al., 2017). TPACK is used to design and implement digital environments, highlight the importance of goals, resources, and knowledge in learning, and support the successful integration of technology into the educational environment (Nurmansyah, 2020; Paidican & Arredondo, 2022). TPACK was adopted as a practical tool for teachers to be able to design and evaluate learning designs. The aim is to encourage teachers to be able to use technology in the learning process. TPACK is the final result of a combination of content, pedagogy and technology which aims to create effective technology-based learning (Kara, 2021; Papanikolaou et al., 2022).

The use of the Problem Based Learning model with the TPACK Approach in several studies has produced positive results for students. Students taught with this model have experienced improvements in their mathematics learning outcomes because PBL with TPACK invites students to learn independently and get more opportunities to practice directly. This can also train critical thinking skills, problem solving, decision making and creative thinking (Chaidam & Poonputta, 2022; Paidican & Arredondo, 2022). In the learning process using the Problem Based Learning model with the TPACK Approach, teachers use technology-based approaches such as showing learning videos which make students more interested in learning so they can improve their learning outcomes. Based on the problems that have been described, the objectives of this research are: analyzing the Problem Based Learning Model with the TPACK Approach in the Numeracy Ability of Class V Elementary School Students.

## 2. METHOD

This research design is experimental research. The type of research used is Quasi Experimental Design with a Non-equivalent Pre-test Post-test Control Group Design research design. Research with this design requires 2 sample classes. One sample class is the experimental class (which will be manipulated or given certain treatment) and the other class will be the control class (which will not be manipulated or not given certain treatment and will only learn with the usual learning or that is often applied by the teacher in class. Before the research was carried out, both the control class and the experimental class will be given a pre-test to determine the initial condition of the research subjects. A post-test will be given when the research / giving special treatment to the experimental group has been completed. The post-test is given to both classes to see the difference in results between the pre -test and post-test.

This research was carried out at SD No. 1 Sibanggede as the experimental group and SD No. 2 Sibangkaja as a control group in the even semester of the 2022/2023 academic year with 30 students in the experimental group and 32 students in the control group. The experimental group was given treatment in the form of a Problem Based Learning model with the TPACK Approach while the control group was not given this model. This research was carried out from January 19 2023 to February 15 2023 on the material of spatial volumes. The data collection method in this research used a test method and a numeracy ability test instrument consisting of objective questions, true-false questions, and matching questions. The instrument used in this research was designed to determine differences in students' numeracy abilities before being treated and after being treated using the Problem Based Learning model with the TPACK Approach. The instruments used were first tested for validity and reliability. The validity test of this research instrument was carried out twice, namely the content validity test by experts in the field and the item validity test with point biserial correlation because this instrument has a score of correct = 1 and incorrect = 0.

In this study, the KR.20 technique was used to measure the reliability of the research instrument because test scores are dichotomous. What is meant by a dichotomous score is that the correct answer is given a score of 1 and the wrong answer is given a score of 0. Based on the results of the calculation of the 20 instrument items which were declared valid, the reliability of the 20 instrument items was tested. Based on the results of the KR.20 test, the r11 value was obtained, namely 0.7. Thus, it can be concluded that the instrument for students' numeracy abilities is reliable, with high reliability criteria. Data Analysis Methods and Techniques in this research use 2 methods, namely Descriptive Statistics and Inferential Statistics.

Descriptive statistics are used to describe data and inferential statistics are used to test hypotheses and come to research conclusions. Before testing the hypothesis, a prerequisite analysis test was carried out in the form of a data normality test using the Kolmogorov Smirnov Test and a data homogeneity test using the Fisher Test (F Test). Hypothesis testing was carried out using the Polled Variance T-test because the data already had a homogeneous variance. With the criteria that if the  $t_{count} \leq t_{table}$ , then  $H_0$  is accepted and  $H_1$  is rejected, and if the  $t_{count} > t_{table}$  then  $H_0$  is rejected and  $H_1$  is accepted at the 5% significance level with  $dk = n_1 + n_2 - 2$ .

### 3. RESULT AND DISCUSSION

#### Result

The numeracy ability of the group of class V students who were taught using the Problem Based Learning model with the TPACK Approach obtained an average score of 77.00 in the medium category. Based on the research results, it can be seen that the highest post-test score in the experimental group was 95 and the lowest score was 50. The experimental group's post-test data had a mean of 77, a median score of 77.5, and a score with the highest frequency (mode) of 90. The magnitude of the value deviation is 12.29, with the value diversity being 151.03. The numeracy ability of the group of class V students who were taught using the Problem Based Learning model with the TPACK Approach obtained an average score of 56.25 in the low category. Based on this research, it can be seen that the highest post-test score in the control group was 80 and the lowest score was 35. The control group's post-test data had an average score of 56.25, the median score was 55, and the mode is 50. The magnitude of the value deviation is 12.23 with the diversity of values being 159.86.

Based on the results of the T polled variance test calculation, the  $t_{count}$  was 6.55. The  $T_{table}$  value with a significance level of 5%,  $dk$  numerator = 1 and  $dk$  denominator = 60 is 2.00. So it can be seen that  $t_{count}$  is greater than  $t_{table}$ ,  $6.55 > 2.00$ . Thus, it can be concluded that there is a difference in the numeracy abilities of students in the group taught using the Problem Based Learning model with the TPACK Approach and the group not taught using this model. The average value of the numeracy abilities of grade 5 students who were taught using the Problem Based Learning model with the TPACK Approach was higher than the average value of the numeracy abilities of students who were not taught using this model. Students who were taught using the Problem Based Learning model with the TPACK approach got an average score of 77.00 with the highest score being 95, the most frequently occurring score (mode) being 90 and the lowest score being 50. This is different from students who were not taught with the model. The average value obtained was 56.25 with the highest value being 80, the most frequently occurring value (mode) being 50 and the lowest value being 35.

Based on this, it can be said that the Problem Based Learning model with the TPACK Approach has a significant influence on the numeracy abilities of fifth grade elementary school students. One of the reasons for this is that the Problem Based Learning model with the TPACK approach provides many opportunities for students to learn independently and is also supported by technology-based learning media. This is also in line with previous research. The results of research regarding the Problem Based Learning Model with the TPACK Approach on students' numeracy abilities found that this model can trigger the students' learning process to carry out more simple research activities so that they can better understand the concepts of the material being studied, as well as with the help of appropriate technology such as animated videos, presentation slides, and LKPD to support the learning process. Using the Problem based Learning model can help increase students' learning independence. (Kanaah & Mardiani, 2022; Suari, 2018).

With the Problem Based Learning model, students can build an independent attitude in learning. This can be seen from students who learn independently and look for additional learning resources independently when they have difficulty solving problems in learning using the Problem Based Learning model. When using the Problem Based Learning model in the classroom, this can improve students' independent learning abilities, improve students' thinking abilities, form students' self-motivation and students' interest in learning because during the learning process students are encouraged to solve problems independently and try to find things. unknown, looking for and trying to understand the meaning of learning.

#### Discussion

From the results of observations when implementing the Problem Based Learning learning model with the TPACK Approach, students in the experimental class started learning by listening to the teacher's explanation of the learning objectives. Then, the teacher will provide directions for conducting research on everyday problems related to the learning material. Students will start doing research and filling in the

LKPD that was distributed by the teacher previously. During research, students will work together with their friends to answer the problems on the LKPD. At this stage the teacher supervises and accompanies each group in conducting research and helps guide groups that are having difficulty. During this mentoring, the teacher provides instructions using power points displayed on the LCD and also shows videos as a complement to theory related to the material being discussed. After conducting research and answering problems on the LKPD, representatives of each group will be appointed by their group to carry out presentations on the results of their respective group discussions.

Each member in a group gets the same opportunity to do research, work on LKPD, or present the results of discussions through presentations to the class. After the presentation activity, the teacher received different answers from each group. In this case, the teacher helps provide conclusions about a concept so that it can be mutually agreed upon so that the class has a correct and uniform understanding of a concept. The learning process with Problem Based Learning begins with an explanation of the problem as well as the learning objectives, after that students will analyze the problems found through research with their group, then students begin to choose solutions that will be used to solve these problems. After there is a solution, students will discuss with their respective groups to draw conclusions about solving the problem. During the learning process using the Problem Based Learning model, students are directed through several learning steps with varied research activities which open up opportunities for students to find solutions to problems they face independently. (Ariyani & Kristin, 2021; Kasuga et al., 2022). Through the stages of the Problem Based Learning model, a case study process occurs with the group through research activities so as to help students understand the concepts that have been taught (Boye & Agyei, 2023; Wicaksana & Sanjaya, 2022).

In the control group, learning activities still implemented learning models commonly used by teachers or models other than Problem Based Learning with the TPACK Approach. In practice, the model used by teachers in control classes tends to be less than optimal. This is caused by learning activities that do not yet connect students with everyday life. Students still rely on the teacher's explanations, copy and note down whatever the teacher explains in front of the class. In this case, teachers carry out more activities than students when implementing learning in the classroom. Learning using the lecture method produces less output in student academics because this method is very dependent on the teacher and learning activities are repetitive in delivering learning material. (Ogwenno et al., 2021; Sitompul et al., 2017). The lecture method is the method most rarely chosen by students because this method is teacher-centred, without visual or other audiovisual media (Helmi, 2016; Laurie Murphy, 2021).

Learning by applying the Problem Based Learning model with the TPACK Approach to numeracy learning content provides students with the opportunity to develop their thinking abilities so that it can encourage students to understand the concept of problems rather than theories regarding a material. Therefore, the results of students' numeracy abilities can be seen from the learning activity steps given to the two groups, the average scores of the two groups, as well as the results of hypothesis testing analysis. Learning using the Problem Based Learning model with the TPACK Approach goes through several stages starting from orienting students to the problem, organizing students to carry out research, guiding research activities, presenting research results, then analyzing and evaluating the solutions provided to the problem. During the learning process, students get many opportunities to play an active role in learning, and learn independently. This learning process then helps students to better understand the concept of the material rather than memorizing the material.

Research with similar results is presented regarding PBL which can have a positive and significant effect on improving students' mathematical literacy skills (Ariyani & Kristin, 2021; Firdaus et al., 2021). Another similar study stated that the application of the Problem Based Learning model with the TPACK Approach was able to increase the numeracy skills of 80% of the total research subjects. (Chaidam & Poonputta, 2022; Tanjung et al., 2022). This increase was also accompanied by students' activeness in the learning process, increasing students' self-confidence in answering problems that required numeracy skills given by the teacher. The Problem Based Learning Model with the TPACK Approach can be chosen and used by teachers in teaching and learning activities, especially in understanding certain material concepts, especially in numeracy material because this model has an influence on students' numeracy abilities.

Thus, choosing an appropriate and appropriate learning model will greatly influence students' numeracy abilities. The research results obtained from this research activity are evidence that the Problem Based Learning model with the TPACK Approach makes a good contribution when applied to mathematics learning in elementary schools. This is because the Problem Based Learning model with the TPACK Approach encourages students to understand the concept of the material based on the problems encountered and resolved during the learning process. The Problem Based Learning Model with the TPACK Approach can be chosen and used by teachers in teaching and learning activities, especially in understanding certain material concepts, especially in numeracy material because this model has an

influence on students' numeracy abilities. This is because the Problem Based Learning model with the TPACK Approach helps students understand the concepts of the subject matter through solving real problems related to students' daily lives.

#### 4. CONCLUSION

Based on the research results, it can be seen that there is a significant difference in the numeracy abilities of the group of students taught using the Problem Based Learning model with the TPACK Approach and the group of students who were not taught using this model. The Problem Based Learning Model with the TPACK Approach can improve the numeracy skills of fifth grade elementary school students. The Problem Based Learning Model with the TPACK Approach encourages students to understand material concepts based on problems encountered and resolved during the learning process.

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