# Improvement of Prospective Teacher Mathematics Reasoning Ability Using Numeration Assisted E-Learning

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**Abstract:** This study aims to examine the improvement of prospective teacher Mathematical Reasoning (KPM) abilities through E-Learning-assisted Numeration learning. This study used a quasi-experimental method with a non-equivalent pretest and posttest control group design. The subjects of this study were mathematics prospective teachers at Universitas PGRI Palembang. namely the experimental class which received E-learning assisted numeracy learning (PNBE) and the control class which received conventional learning (PK). Based on the results of the analysis of the difference in the mean difference in the KPM increase of prospective teachers who received PNBE learning and prospective teacher who received conventional learning, the scores from the table of increasing KPM of students who received E-learning-assisted Numeration learning (PNBE) were better than a prospective teacher who received conventional learning. Based on the results of data analysis, it can be concluded that numeracy skills and mathematical reasoning abilities of fourth-semester prospective teacher PGSD at PGRI university are quite good. It is recommended for teaching staff/lecturers to be able to try out this learning model on other mathematical abilities.

**Keywords**: Improvement; Reasoning; Numeration; E-Learning

## Introduction

Mathematics learning is a subject for the development of a student's thinking ability from elementary to middle to tertiary levels to equip students to improve their logical, critical, and creative thinking skills in the school environment and the community, Jayanti (2021). Mathematics is one of the disciplines in improving the ability to think and argue, contribute to solving everyday problems in the real world, and provide support for the development of science and technology in Darmayanti (2016), (Gusti, 2020:205). Mathematics is an ideal subject that develops children's thinking and communication skills starting from the age of primary education to Nasution's higher education (Ahmad, 2018: 390).

The learning process according to Dalyono, Bambang & Agustina, Dwi Forgive. (2016) are usually done face-to-face either directly at school between teachers and students, but since the Covid-19 pandemic, face-to-face activities have been carried out online. Barkah,

(2020) concludes that online learning methods prevent the spread by always keeping a distance so that it demands more creative and innovative teachers or instructors. At the international level, NEA (2011) states that to compete in the global era, students must become proficient communicators, creators, critical thinkers, and collaborators. The Ministry of Education and Culture (2017) sees 21st-century competencies as having critical thinking and problem-solving skills, communication skills, creativity and innovation, and collaboration.

Numerical ability is an ability that must be obtained by students such as giving reasons and conveying ideas effectively, formulating, solving, and interpreting mathematical problems in various forms and situations. Program for International Student Assessment (PISA) at Hartatik (2020). Numeration is the ability/expertise in numbers to be used in practically solving various everyday problems according to Goos (2011). The knowledge and skills of the G.L.N Team (2017) are used in numbers and symbols to solve everyday life problems. The results of a survey conducted by the Program for International Student Assessment (PISA) 2018 assessing global education problems, including regarding education in Indonesia, in the category of reading, science, and math skills, Indonesia's score is low because it is ranked 74th out of 79 countries. Based on the results of the OECD (Organization for Economic Co-operation and Development) survey for the 2009-2018 survey period, Indonesia has always been in the bottom 10, out of three categories, namely reading skills, science, and mathematics. Indonesia's score is always below the average, this is a serious problem that must be faced by education in Indonesia, please note that PISA is one of the three-year programs initiated by the OECD (Organization for Economic Co-operation and Development) to measure learning competencies. global learners. (Narut, 2019:65).

One suitable approach where this research introduces numeracy learning about numeracy and also when learning introduces numeracy through PMRI in line with previous research on the characteristics of elementary mathematics learning is the Realistic Mathematics Education (PMRI) approach assisted by Elearning (Jayanti, 2020). Because this approach is very suitable to be applied to mathematics lessons where the PMRI approach is centered on students who can form their knowledge through their activities in the classroom (Zulkardi 2020). The PMRI approach is a learning approach that is more concerned with student activities in the learning process in the classroom so that students can build their knowledge of the problems that exist in mathematics. Idris (2016:74), (Risdyanti, (2018), is also in line with research on PMRI Using Problems), Putri RII (2019).

TIMSS and PISA (Aulya, 2013:2) are two world institutions that administer tests, one of which is intended for junior high school students who have been randomly selected from each country. PISA 2009 was attended by 65 countries and TIMSS 2011 was attended by 45 countries. The results of PISA 2009 showed that the average score of Indonesian students' mathematics was 371, with an average international score of 496. Furthermore, Cheung (2012:45) revealed that PISA aims to measure mathematical ability which is defined as the ability of students to formulate, use and interpret mathematics in various mathematical contexts, which include mathematical reasoning and the use of mathematical concepts, procedures, facts, tools to describe, explain, and predict phenomena.

After seeing the information above, the importance of PMRI learning carried out in class where it is given according to the characteristics and principles of PMRI and also by providing Numeration-based questions with PISA content to see the reasoning ability of elementary students which is so important in its application which requires a lot of knowledge to be applied and developed skills. reasoning to students later. Therefore, the purpose of this study is to see: The improvement of prospective teacher mathematical

reasoning abilities after receiving the numeracy learning model assisted by e-learning and conventional learning in terms of (a) all students; and (b) KAM (high, medium, and low).

## Research Methods

Berisi jenis penelitian, waktu dan tempat penelitian, target/sasaran, subjek penelitian,

This research is experimental because the treatment is tested and its effect is measured on the sample groups. In its implementation, the sample is not grouped randomly but accepts the state of the subject as it is. Thus this research method is Quasi-Experimental (Sugiyono, 2019;).

To obtain information and control the equivalence of the initial ability of the research subjects, a pretest was used. If there are differences in the post-test scores of the sample groups, it can be suspected that there is a different treatment or not. Therefore, the experimental design used in this study is a nonequivalent Pre-Test and Post-Test Control-Group Design (Creswell, 2012). Briefly, the experimental design can be described as follows. Figure 1. Experiment Design

| O | X | O |
|---|---|---|
| O | | O |
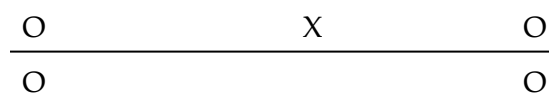
Information :
O : pretest/posttest KPM
X : e-Learning Assisted numeracy learning

Table 1. The Relationship Between Mathematical Reasoning Ability and Learning, and Prospective Teacher Initial Ability

| Group KAM | KPM | |
|---|---|---|
| | PNBE | PK |
| Low (R) | KPM- PNBE -R | KPM-PK-R |
| Medium (S) | KPM- PNBE -S | KPM-PK-S |
| Height (T) | KPM- PNBE -T | KPM-PK-T |
| Overall (L) | KPM- PNBE -L | KPM-PK-L |

Information :

KPM : Ability Reasoning Mathematically

PNBE : E-Learning Assisted Numerical Learning
PK : Pembelajaran Conventional

## Data Analysis Technique

The data analysis technique is a method used by researchers to manage the data that has been collected and classified according to the research objectives (Noor, 2017:48). The test used to measure the level of completeness of student learning outcomes in the cognitive domain, namely in the form of values obtained from the implementation of the pretest (pretest) and the final test (posttest) in mathematics subjects can use the following of Arikunto, (2016:272). After the learning outcomes are obtained, then the next step is to compare the results of the pretest and posttest. Because this study has a goal, namely to determine the improvement of student learning outcomes after the implementation of the reasoning ability model in mathematics subjects using the Normalized Gain test. The normalized gain formula according to Hake (Kesumawati et al, 2017:161) is as follows:

$$(g) = \frac{postest\ score-\ pretesst\ score}{ideal\ ideal-prestest\ score}$$

The calculation results are then interpreted using the Normalized Gain index and can be seen in the table below:

Table 2. Normalized Gain Index

| Normalized Gain Value | Interpretation |
|---|---|
| $g \geq 0{,}70$ | High |
| $0{,}30 \leq g < 0{,}70$ | Medium |
| $g < 0{,}3$ | Low |

(Sources: Kesumawati et al, 2017)

## Result and Discussion

The data obtained by KAM by looking at the semester scores of students in semester fourth courses, where the researcher once gave calculus questions, descriptive statistics of TKAM score data based on the research sample class are presented in table 2.

Table 3. Table of Descriptive Statistics of TKAM Data

| Research Sample Class | Score | | Average | Standard deviation | N |
|---|---|---|---|---|---|
| | Min | Max | | | |
| A | 4.80 | 9 | 7,661 | 0.98396 | 36 |
| B | 4.80 | 9 | 7.4 | 1.08432 | 34 |

Based on the table above, the mean standard deviation of each generative class is not the same. Furthermore, it will be tested statistically whether the mean of the two sample classes is significantly equal (same). Before performing the mean difference test, first, the normality test and the homogeneity test of variance of the two groups of data were tested. The normality test used the Kolmogorov-Smirnov (KS) test, while the homogeneity of variance test used the Leven e test. For a summary of the results of the normality test for TKAM data, it is presented in the table, and the results of the homogeneity test in the table below

Table 4. TKAM Data Normality Test Based on Sample Class

| Study group (Class) | N | KS | Sig | H 0 |
|---|---|---|---|---|
| A | 36 | 0.196 | 0.001 | Rejected |
| B | 34 | 0.250 | 0.000 | Rejected |

Note: H 0 = Data is not normally distributed

Table 5 TKAM Data Homogeneity Test Based on Sample Class

| Study group (Class) | F | Sig | Ho |
|---|---|---|---|
| A | 0.935 | 0.337 | Accepted |
| B | | | |

Note: H 0 = Homogeneous data variance

From the Table 4., it can be seen that the probability value (sig) of class A and B TKAM data is smaller than the significant level of 0.05, so H 0 is rejected. This means that the data is not normally distributed. For the homogeneity test, it is known that the TKAM data is also greater than the significant level of 0.05, this also means that but this is not meaningful because the normality test has shown that the data are not normally distributed. Thus, because the data are not normally distributed and homogeneous, to determine the equality of the average class A and B, non-parametric statistics are used, namely the Mann-Whitney test with the following hypothesis. The summary of the results of the Mann-Whitney test can be found in the following table.

Table 6. Mann-Whitney test

| Study group (Class) | N | Sig | Ho |
|---|---|---|---|
| A | 36 | 0.361 | Accepted |
| B | 34 | | |

The table shows that the value of sig. Greater than the 0.05 significance level, so H 0 is accepted. That is, there is no significant difference in the mean TKAM data for research sample classes A and B. These results conclude that students in the two research sample classes, A and B, have the same initial student abilities.

a. Determine the class that will be used as the experimental class and the control class. The class was chosen randomly from two sample classes from the two research sample classes, namely classes A and B. Based on random results, class A was selected as the experimental class and class B as the control class.

**Data Collection Technique**

Data collection methods used in this study are:
1) Test, the test method is used to determine and evaluate students' abilities. In this study, there are two kinds te s used are test to the inability early mathematics (TKAM), and test the ability of reasoning mathematically (TKPM)

The following is a description of each test instrument used:
a) Student Initial Ability Test (TKAM)

Students' initial ability (KAM) is the mathematical ability possessed by students before the learning in this study was carried out. TKAM aims to determine the equality of students' abilities in numeracy learning and conventional learning, besides that it is also used for student placement. The TKAM used by Jayanti (2021 ) has been tested for validity and reliability. Based on this TKAM score, students are grouped into 3, namely the high group (T), the medium group (S), and the low group (R).

To classify students into three groups (high, medium, low) grouping criteria are used based on the mean score and standard deviation (s) according to Arikunto (2012) which can be seen in Table 7 and the distribution of students in each class based on KAM can be seen in the table below:

Table 7. Descriptive Statistics of TKAM Data based on Research Sample Class

| Research Sample Class | Amount | Low ability | Currently | Tall |
|---|---|---|---|---|
| A (Experiment) | 36 | 4 | 24 | 8 |
| B (Control) | 34 | 9 | 21 | 4 |

b) Mathematical Reasoning AbilityTest (TKPM)

The purpose of the compilers of the mathematical reasoning test questions in this study is to measure the mathematical reasoning ability (KPM) of students. The material tested in the TKPM is arranged in the form of a description test of 4 structured questions, consisting of 10 indicators on the question Chan dan Ismail (2014). The questions given are arranged based on the indicators of reasoning ability in this study, namely: (1) finding patterns or properties of mathematical phenomena to make generalizations, (2) performing mathematical manipulations, (3) proposing conjectures, and (4) drawing conclusions and compiling evidence. and give reasons.

**Description of Research Data**

1) Mathematical Reasoning Ability Test (KPM)

Before carrying out the test, the analytical prerequisites were tested, namely the normality test of the data and the homogeneity of variance test. The summary of the results of the normality test is presented in Table 8 and the homogeneity test is in Table 8

Table 8. Data Normality Test Improving Mathematical Reasoning Ability Based on Learning and KAM

| KAM Group | Learning | N | KS | Sig | H o |
|---|---|---|---|---|---|
| Whole | P NBE | 36 | 0.967 | 0.309 | accepted |
| | PK | 34 | 1.009 | 0.206 | accepted |
| Tall | P NBE | 8 | 0.915 | 0.372 | accepted |
| | PK | 4 | 0.460 | 0.984 | accepted |
| Currently | P NBE | 24 | 0.774 | 0.587 | accepted |
| | PK | 21 | 0.873 | 0.431 | accepted |
| Low | P NBE | 4 | 0.507 | 0.959 | accepted |
| | PK | 9 | 0.437 | 0.992 | accepted |

H o : The data on the increase in KPM based on learning is normally distributed

Table 9. Population Variance Homogeneity Test Increased KPM Based on KAM Learning

| KAM Group | Statistics Levene (F) | Sig. | H o |
|---|---|---|---|
| Whole | 0.432 | 0.514 | Accepted |
| Tall | 0.899 | 0.365 | Accepted |
| Currently | 0.007 | 0.936 | Accepted |
| Low | 0.105 | 0.752 | Accepted |

H o : Variance between groups of homogeneous KPM increase data

It can be seen in the table above, namely, in Table 7 and Table 8 it can be seen that the data on the increase in KPM in the PNBE and PK groups are normally distributed and the variance is homogeneous. Therefore, to find out whether there is a difference in the mean increase in KPM between the two learning groups (PNBE and PK) it can be done using a t-test. The summary of the results of the t-test can be seen in the following table:

Table 10. Test of Differences in Mean Data of Increase in KPM
Based on Learning and KAM

| KAM Group | Learning | Average | T | Sig. | H o |
|---|---|---|---|---|---|
| Whole | PNBE | 0.4545 | -5,827 | 0.000 | rejected |
| | PK | 0.3190 | | | |
| Tall | PNBE | 0.5512 | -0.899 | 0.028 | rejected |
| | PK | 0.4042 | | | |
| Currently | PNBE | 0.4266 | -3,608 | 0.001 | rejected |
| | PK | 0.3278 | | | |
| Low | PNBE | 0.428 | -4.757 | 0.001 | rejected |
| | PK | 0.2605 | | | |

H o : There is no difference in the mean score of increasing CAR between the two data groups

To find out whether there are differences in the improvement of KPM students who receive numeracy learning and students who receive conventional learning, both viewed as a whole and based on learning and KAM, a hypothesis is proposed along with the following conclusions :

**For Hypothesis 1:**
Students who got the learning numeracy assisted e-learning gained improvement ability reasoning mathematically much better than students who received conventional learning in terms of the whole.

**So Conclusion 1:**
Based on the results of the analysis of the difference in the average increase and the average increase in the KPM of students who received e-learning -assisted numeracy learning and students who received conventional learning, it can be concluded that the overall increase in KPM of students who received numeracy learning was better than students who received conventional learning.

**For Hypothesis 2:**
Students who receive e-learning -assisted numeracy learning get an increase in their mathematical reasoning abilities better than students who receive conventional learning in terms of high KAM.

**Then Conclusion 2:**
By paying attention to the average value of the increase in KPM and the results of the statistical test of differences in the two groups of data on the increase in student KP M based on high KAM, it can be concluded that the increase in KPM students who receive numeracy learning assisted by e-learning is better than students who receive conventional learning viewed from a high KAM.

**For Hypothesis 3:**
Students got the learning numeracy assisted e-learning improvement ability reasoning mathematically better than students who received conventional learning in terms of KAM being.

**So Conclusion 3:**

By paying attention to the average value of the increase in KPM and the results of statistical tests of differences in the two groups of data on the increase in student KPM based on medium KAM, it can be concluded that the increase in KPM of students who received numeracy learning was better than students who received conventional learning in terms of moderate KAM.

**For Hypothesis 4:**

Students who receive e-learning-assisted numeracy learning get an increase in their mathematical reasoning abilities better than students who receive conventional learning in terms of low KAM.

**Then Conclusion 4:**

By paying attention to the average value of the increase in KPM and the results of the statistical test of differences in the two groups of data on the increase in student CAR based on low KAM, it can be concluded that the increase in KPM of students who receive e-learning -assisted numeracy learning is better than students who receive conventional learning in terms of low KAM.

Based on table 9, of same the research, Ulpah (2013) and Dewi (2015) is the research to improve the research. It appears that the overall increase in the KPM of students who received numeracy learning was greater than that of students who received conventional learning. KPM enhancement of students with learning numeracy as well as those getting conventional learning in terms of whole the average with moderate (enough) category.

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## Conclusion

Based on the results of data analysis, it can be concluded that: Numeracy skills and mathematical reasoning abilities of fourth-semester prospective teacher of elementary school teacher education (PGSD) at PGRI University are quite good. The results of the analysis of the increase in KPM for a prospective teacher who received e-learning-assisted numeracy learning (PNBE) were better than students who received conventional learning. Because it is known that the initial ability of numeracy is quite good, it is recommended for teachers/lecturers to be able to test this learning model on other mathematical abilities.

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