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An Experimental Study: Creative Problem-Solving Learning Model with Kebumen Tourism Realistic Approach to Improve Numerical Literacy toward 8th-Grade Students

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Abstract

The preliminary study found that students who reached the minimum competency limit of numerical literacy in *Asesmen Kompetensi Minimum* (AKM) 2021 were less than 50% and below the average value. Thus, this research aimed to determine whether the Creative Problem-Solving (CPS) learning model with Kebumen tourism realistic approach can improve numerical literacy. This research used a quantitative approach which was a quasi-experimental posttest-only design. The population studied was 243 8th-grade students of SMP Negeri 2 Kutowinangun in Kebumen for the academic year 2022/2023 with 2 classes as the sample which was obtained by random sampling. The instruments used were numerical literacy questions paper and the blueprint, answer key, and scoring guidelines. The conclusion was the CPS learning model with Kebumen tourism realistic approach was effective for increasing the numerical literacy of the population rather than the learning model applied by the class teacher. It was proved by these conditions: (1) students' numerical literacy test mean value in the experimental group achieved individual learning mastery, (2) the proportion of students' numerical literacy test value in the experimental group achieved classical learning mastery, (3) the numerical literacy test mean value of the experimental group is better than the numerical literacy test mean value of the control group.

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1. Introduction

In 2019, the Indonesian Minister of Education and Culture, Nadiem Makarim, issued a new policy for education in Indonesia, namely *Merdeka Belajar* (Freedom Learning). One of the *Merdeka Belajar* policies is the abolition of the National Examination to be replaced with a National Assessment, one of which is the *Asesmen Kompetensi Minimum* (Minimum Competency Assessment). It is abbreviated as AKM and had been implemented for the first time in 2021. AKM assesses students' numerical literacy and students' reading literacy. This assessment refers to international assessments, which are the Program for International Student Assessment (PISA) and Trends in International Mathematics and Science Study (TIMSS). Therefore, aspects of numerical literacy in AKM have some similarities with mathematical literacy in PISA.

Students' mathematical literacy in Indonesia is still low, as shown by PISA and TIMSS data. The last PISA survey was carried out in 2018 and will be carried out again four years after that, in 2022, because of the delay due to the COVID-19 pandemic in the world. From PISA data, in 2018 Indonesia was ranked seventh lowest, which was ranked 73 out of 79 countries participating in the survey with a mathematical literacy value of 379. This value was below the PISA mean value which was 489 (OECD, 2019: 78). In the 2011 TIMSS, Indonesia valued 386 for 8th-grade students. This value is also below the TIMSS mean value of 500 and is categorized as a low level (Hadi & Novaliyosi, 2019). For the latest data, the lack of numerical

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literacy of students in Indonesia is also shown by the 2021 AKM results. The results that were released on January 19th, 2022 on the official website, https://pusmendik.kemdikbud.go.id/, was shown that all levels of Junior High Schools or other secondary schools in all provinces in Indonesia have numerical literacy below the minimum competency limit with details from a total of 1,779,270 participants, there are less than 50% students who achieved minimum competency limit.

The school that became the location of this research was SMP Negeri 2 Kutowinangun. This school is located in Kebumen Regency, Central Java Province, Indonesia. From the results of the AKM, all levels of Junior High School or other secondary schools in Kebumen had numerical literacy below the minimum competency limit with details from a total of 6,620 participants there were less than 50% of students who achieved the minimum competency limit. In addition, in terms of urban-rural areas and socio-economic aspects, there are no difference of numerical literacy. Then, based on data from a preliminary study conducted by researchers at SMP Negeri 2 Kutowinangun, numerical literacy in this school is still below the minimum competency limit. The numerical literacy value obtained is 1.73. This value is below the district level average literacy score of 1.76. From a total of 49 students who participated, it was found that students who reached the minimum competency limit were less than 50%.

Low numerical literacy is influenced by internal factors and external factors. As explained by Mahdiansyah & Rahmawati (2014) in their research, internal factors are the factors within students, such as students' intellectual abilities, students' verbal abilities, students' counting abilities, and non-cognitive abilities. Then, external factors are from outside the student's self, those are instructional factors and environmental factors. In terms of environmental factors, several things that influence numerical literacy are environmental conditions and school culture, school-owned learning media, teacher characteristics, and the socio-economic conditions of students' parents. In terms of instructional factors, several things that can influence numerical literacy are learning models, teaching methods, teaching intensity, and the quality of the teacher in delivering the material.

Unfortunately, the results of National Assessment showed that the improvement of learning by the teacher in SMPN 2 Kutowinangun is passive with descriptions of efforts to improve the quality of learning sporadically just to complete assignments, the teacher uses repetitive methods to carry out learning, and there is no visible reflective process. Then, for the application of innovative practices, the application is also passive with a description of teachers passively looking for new teaching methods, resources and strategies in the framework of carrying out learning innovations to increase students' interest, involvement and understanding of learning material. Therefore, the exploration of learning models is needed to increase numerical literacy.

The learning model which appropriates for the improvement of numerical literacy is problem-based model because mathematics is all about solving the problem. As stated by Suminar & Rahman (2022) that mathematical problem-solving abilities could develop students' numerical literacy. One of the problem-based learning models is Creative Problem Solving (CPS) learning model. Considering that problem-solving abilities could develop numerical literacy, the researcher suspected that the CPS model was effective for increasing numerical literacy.

In addition, the learning approach also has an important influence on achieving learning objectives. One appropriate learning approach to improve numerical literacy is a realistic approach. Numerical literacy is closely related to real life so that if students are taught using a realistic approach, students are used to seeing mathematics in real life. In addition, if learning mathematics uses a realistic approach, students are expected to be able to imagine abstract mathematics to become mathematics that is familiar to students so that learning activities will be more meaningful. The realistic approach of mathematics learning is usually called Realistic Mathematics Education (RME) and has been developed in the Netherlands. However, Indonesia itself has developed RME by adjusting Indonesia's realistic region. This approach is called *Pendidikan Matematika Realistik Indonesia* (PMRI).

Numerical literacy in Indonesia’s education is still relatively a new thing. Nevertheless, there were several studies that had discussed it. The research by Putra & Mukhtar (2022) showed that video-assisted culture-based Western Sumatra for mathematics learning was effective to improve numerical literacy of 8th-grade students in JHS 12 Padang, Western Sumatra, Indonesia. Result of research by Fitriyanasari, Wardono, & Isnarto (2022) stated that learning with the discovery learning model assisted by Google Classroom was qualified to improve students' numerical literacy toward fifth grade students at SDN 1 Gondosari, Kudus, Central Java, Indonesia. The other research that was conducted by Nur, Herman & Dahlan (2022) described a numerical literacy skill in early childhood students.

The study from Purwaningrum, Ahyani, & Utomo (2022) concluded that digital based modules were needed by dyscalculia students in Kudus Regency, Central Java, Indonesia, especially in mathematics. Then, the study from Drábeková, Rumanová, & Pavlovičová (2022) revealed the issue of financial literacy in school education in the Slovakia and concluded that there was a strong relationship between numeracy and financial literacy. However, the researcher has not found experimental research on numerical literacy using Creative Problem-Solving learning model and realistic approach, especially among secondary school students in Kebumen, Central Java, Indonesia.

According to Van Galen & Van Eerde (Nusantara, Zulkardi, & Putri, 2021) utilizing context in a mathematical problem can attract and stimulate students to initiate learning. From the research by Salgado (2017), the results indicated that in average, 80.5% of students in schools answered correctly problems embedded in more familiar context to students and 67.5% answered correctly the problems embedded in unfamiliar contexts. Kohar et al (2019) stated that students' mathematics learning can be positively influenced by tasks teachers pose through their content, pedagogical, and contextual knowledge. From that, the issue of competency of teachers as well as student teacher as future teacher to design context-based tasks needs to be addressed more actively in current research trend in teacher education. Furthermore, according to Ekawati et al (2017), context-based mathematics problem can foster students' mathematical competencies when solving problems. The context-based mathematics problem has been indicated to have a potential effect on activating their fundamental mathematical capabilities.

The context that is familiar to students at the school where this research was conducted is tourism in Kebumen. By using the tourism context in Kebumen, it is hoped that it will stimulate fun learning activities for students so that students can take the initiative to learn. In addition, students are expected to be able to imagine abstract mathematics to be more real so that students are accustomed to seeing mathematics in the context of their area of residence, Kebumen. That way, little by little students will get used to the problems of numerical literacy so that their numeracy skills will increase.

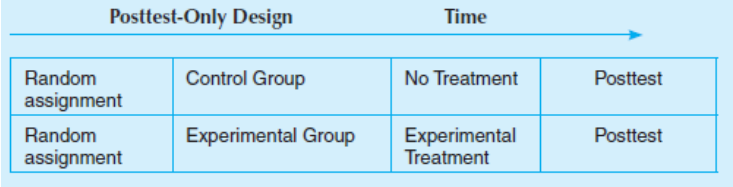
Therefore, this study focused on numerical literacy in the Creative Problem-Solving learning model using realistic approach with Kebumen tourism context toward students in one of the secondary schools in Kebumen. This study aims to determine whether the Creative Problem-Solving learning model with Kebumen tourism realistic approach can improve numerical literacy effectively toward 8th-grade students in SMP Negeri 2 Kutowinangun, which is located in Kebumen.

Based on the background explanation, the formulation of the problems in this study was (1) do the students' numerical literacy test values in the group given Creative Problem-Solving learning model with Kebumen tourism realistic approach achieve learning mastery individually?, (2) do the proportion of students' numerical literacy test values in the group given the Creative Problem-Solving learning model with Kebumen tourism realistic approach achieve learning mastery classically?, and (3) is the mean value of the numerical literacy test in the group that was given the Creative Problem-Solving learning model with Kebumen tourism realistic approach better than the mean value of the numerical literacy test in the group that used the learning model applied by the class teacher?

2. Methods

2.1. Design and Research Approach

This study was experimental research and used quantitative approach. The quantitative approach design was a quasi-experimental posttest-only design. Because of this research was conducted at school, there are academic calendar and school systems that cannot be disrupted. It means, the researcher cannot take random assignment to create new groups for the experiment in order not to disrupt classroom learning. As stated by Creswell (2012), quasi-experimental design is the development of true experimental design because in some research several conditions cannot take random assignment to create new groups for the experiment, but must use existing intact groups. The following is the chart of quasi-experimental posttest-only design.



(Source: Cresswell, 2012)
Figure 1. Chart of Quasi-Experimental Posttest-Only Design

2.2 Population and Research Samples
The population studied was 243 8th-grade students in SMP Negeri 2 Kutowinangun for the academic year 2022/2023 with 2 classes as the samples. The research samples were obtained from random sampling. According to Creswell (2012), random sampling is a sampling technique in which the researcher selects participants (or a unit, such as a school) so that all participants in the population have the same probability of being selected as a sample. Because the quantitative research in this study used a quasi-experimental design, thus the researchers took samples by selecting classes that had been formed randomly, not assigning individuals randomly so it would not disrupt classroom learning. There are eight clasess for 8th-grade. Before taking the samples, all classes should be in same condition. According to initial data analysis by using one-way analysis of variance, the pairs of the classes that were in the same condition are 8B-8A, 8C-8A, 8C-8B, 8D-8A, 8D-8B, 8D-8C, 8E-8A, 8E-8B, 8E-8C, 8E-8D, 8F-8A, 8F-8B, 8F-8C, 8F-8D, 8G-8C, 8G-8E, 8H-8E, 8H-8G. From these pairs, 1 pair was taken randomly so that 1 class became the control group and the other became the experimental group. The two classes selected as samples were class 8G as the experimental group and class 8H as the control group. For class 8G there are 25 students and for class 8H there are 26 students.

2.3 Research Variables
Variables in this research consisted of treatment variable and dependent variable. According to Creswell (2012), treatment variables are independent variables that the researcher manipulates to determine their effect on the outcome, or dependent variable. The treatment variable in this study was the type of teaching. The conditions of the treatment variables were categorized into two intervention conditions, those were: (1) control group received teaching using the model applied by the class teacher that was expository learning model, and (2) experimental group received teaching using the CPS learning model with Kebumen tourism realistic approach. A dependent variable is an attribute or characteristic that is dependent on or influenced by the independent variable (Creswell, 2012). Dependent variable in this study was students' numerical literacy.

2.4 Data Collection Techniques
For collecting the data, the researcher used numerical literacy test that was given to both control and experimental groups. The instruments used for numerical literacy test were numerical literacy questions paper, blueprint of numerical literacy questions paper, answer key, and scoring guidelines. The instruments used in conducting the treatment were a set of learning device using CPS-Kebumen tourism realistic approach and a set of learning device using expository learning model.

2.5 Data Analysis Techniques
There were two stages in analysing quantitative data. In the initial data analysis, the data were the value of midterm test from the class teacher. This initial data analysis was used to find out that the classes were in the same condition to be used as control group and experimental group before being given treatment. At this stage, the normality test, homogeneity test, and one-way analysis of variance test were carried out.

In the final data analysis, the data was from students' numerical literacy test values. The final stage of data analysis was used to test the hypothesis. At this stage, the normality test, homogeneity test, hypothesis 1 testing (one tail mean test), hypothesis 2 testing (one tail proportion test) and hypothesis 3 testing (one tail two mean difference test) were carried out.

3. Results & Discussions

3.1. Results

The numerical literacy test was conducted on November 17th-18th, 2022. From final data analysis, the experimental and control groups were normally distributed and had the same variance or homogeneous. Thus, the requirements to carry out comparative hypotheses testing were met.

3.1.1 Hypothesis 1 Testing (One-tail Mean Test)

In this research, the Minimum Criteria of Mastery Learning was set with a value of 54 according to actual pass limit. The test value called passed if the value is above $(X + 0{,}25\ SD)$ where X is mean and SD is standard deviation. Thus, students achieved mastery learning individually if the mean value on the numerical literacy test was greater than or equal to 54. The hypotheses were as follows.

H_0: $\mu \leq 53{,}9$ (the mean value of numerical literacy test in experimental group did not achieve the mastery learning individually).

H_1: $\mu > 53{,}9$ (the mean value of numerical literacy test in experimental group achieve the mastery learning individually).

This study used $\alpha = 5\%$, obtained probability $= 0{,}95$, and $df = 23$. The testing criteria was if $t_{value} < t_{1-\alpha}$ then H_0 accepted so H_1 rejected and otherwise. From t-table, $t_{1-\alpha} = 1{,}714$. From calculation, $t_{value} = 5{,}998$. It meant $t_{value} > t_{1-\alpha}$. According to testing criteria, H_0 rejected so H_1 accepted. It meant the mean value of numerical literacy test in experimental group achieved the mastery learning individually.

3.1.3 Hypothesis 2 Testing (One-tail Proportion Test for Final Data)

As stated by Masrukan (2017), mastery learning classically can be achieved if at least 75% of the students participating in the lesson achieved the Minimum Criteria of Mastery Learning. The hypotheses were as follows.

H_0: $\pi \leq 0{,}749$ (proportion of numerical literacy test values in experimental group did not achieve learning mastery classically).

H_1: $\pi > 0{,}749$ (proportion of numerical literacy test values in experimental group achieve learning mastery classically).

This study used $\alpha = 5\%$ and obtained probability $= 0{,}95$. The testing criteria was if $z_{value} < z_{0{,}5-\alpha}$ then H_0 accepted so H_1 rejected and otherwise. From z-table, $z_{0{,}5-\alpha} = 1{,}64$. From calculation, $z_{value} = 1{,}894$. It meant $z_{value} > z_{0{,}5-\alpha}$. According to testing criteria, H_0 rejected so H_1 accepted. It meant the proportion of numerical literacy test values in experimental group achieved learning mastery classically.

3.1.4 Hypothesis 3 Test (One-tail Two Mean Difference Test for Final Data)

This hypothesis testing is used to compare the numerical literacy data from the experimental group and the control group. The hypotheses were as follows.

H_0: $\mu_1 \leq \mu_2$ (the mean value of numerical literacy test in experimental group is not better than control group).

H_1: $\mu_1 > \mu_2$ (the mean value of numerical literacy test in experimental group is better than control group).

This study used $\alpha = 5\%$, obtained probability $= 0{,}95$, and $df = 48$. The testing criteria was if $t_{value} \geq t_{1-\alpha}$ then H_0 accepted so H_1 rejected and otherwise. From t-table, $t_{1-\alpha} = 1{,}677$. From calculation, $t_{value} = 0.973$. It meant $t_{value} < t_{1-\alpha}$. According to testing criteria, H_0 rejected so H_1 accepted. It meant the mean value of numerical literacy test in experimental group was better than control group.

3.2. Discussions

After the numerical literacy test was carried out, the mean value of the experimental group was 68.96 and the control group was 64.77. Based on data analysis, the result of hypothesis 1 testing was the numerical literacy test mean value of students in the experimental group achieved individual learning mastery. This means that the students' mean value reached the Minimal Criteria of Mastery Learning, which is 54. Then, for the result of hypothesis 2 testing, it was obtained that the proportion of students' numerical literacy test

value in the experimental group achieved classical learning mastery. This means that the number of students who complete the Minimal Criteria of Mastery Learning reached 75%. Last, from the result of hypothesis 3 testing, it was known that the numerical literacy test mean value of the experimental group is better than the numerical literacy test mean value of the control group. By fulfilling that three criterias, the Creative Problem-Solving learning model with a realistic approach to Kebumen tourism can be said to be effective in increasing the numerical literacy of grade 8 students at SMP Negeri 2 Kutowinangun.

Numerical literacy in Indonesia's education is still relatively a new thing, therefore not many experimental studies have discussed it, especially the use of the CPS learning model to increase numerical literacy. However, several previous studies found that the CPS learning model was able to increase mathematical literacy. One of the studies that examined mathematical literacy was conducted by Azmi et al. (2018). From the research results, it was concluded that the CPS-RME learning model was effective for increasing students' mathematical literacy. It was known that the mean value of students' mathematical literacy in learning using the CPS-RME model was better than the mean value of students' mathematical literacy in learning using the expository learning model. In addition, Ovan & Sunyoto Eko (2017) on their mixed method research concluded that learning using the PISA-CPS model was effective on students' mathematical literacy abilities.

In numerical literacy, critical thinking has an important role in solving problems encountered. Critical thinking is the basis for finding solutions to problems so that students can apply mathematical concepts and reasoning. Therefore, the expository learning model is considered not suitable for increasing numerical literacy. This is shown by research by Agustin et al. (2014) who found that the mean value of problem-solving ability test in the group using the CPS model was higher than the mean value of problem-solving ability test in the group using the expository learning model. Then, the other study by Mardiana et al. (2019) showed that students' mathematics learning outcomes in groups that received realistic learning were higher than students' mathematics learning outcomes in groups that used expository learning for statistics material.

4. Conclusions

Based on the results and discussion, the conclusions is the Creative Problem-Solving learning model with Kebumen tourism realistic approach is effective for increasing the numerical literacy of 8th grade students of SMP Negeri 2 Kutowinangun, which is located in Kebumen, rather than the learning model applied by the class teacher, that is expository learning model. The effectiveness was proved by three conditions: (1) numerical literacy test mean value of students in the experimental group achieved individual learning mastery, (2) the proportion of students' numerical literacy test value in the experimental group achieved classical learning mastery, (3) the numerical literacy test mean value of the experimental group is better than the numerical literacy test mean value of the control group.

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