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HIGHER ORDER THINKING SKILLS IN MATHEMATICS AT ELEMENTARY SCHOOL

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Abstract
This research aims to describe creative thinking skills and mathematical problem solving abilities through the application of a project-based learning model. This research uses a quantitative approach with a quasi-experimental method with a posttest-only group design. The sample consisted of 53 students in class V of elementary schools in East Manggarai district which consist two class, with details in the experimental class total 27 people and the control class total 26 people. The sampling technique uses random sampling technique. Data collection techniques use test techniques. The tests used are descriptive tests both to measure creative thinking skills and for data about problem solving abilities. Based on the reliability test results, all items are in the high category. The data analysis technique using MANOVA with the help of SPSS 23.00. The asumtion tests used are data normality test, data homogeneity test, and multicolinearity test. Research findings show that both separately and simultaneously the creative thinking ability and problem solving ability of students who receive learning using the project-based learning model is higher than students who receive learning with conventional models. The project model also has a strong and important impact on the creative thinking abilities and mathematical problem solving abilities of elementary school students. In conclusion, the implementation of the project-based learning model is one of the alternative choices used by teachers for creativity in learning mathematics in elementary schools.
Keywords: *creative thinking skills; problem solving ability; project-based learning*

Abstrak
Penelitian ini bertujuan mendeskripsikan keterampilan berpikir kreatif dan kemampuan pemecahan masalah matematika melalui penerapan model pembelajaran berbasis proyek. Dalam penelitian ini menggunakan pendekatan kuantitatif dengan metode quasi-experiment with posttest-only group design. Adapun sampel berjumlah 53 peserta didik kelas V Sekolah Dasar yang terdiri atas dua kelas di kabupaten Manggarai Timur dengan rincian kelas eksperimen berjumlah 27 orang dan kelas kontrol berjumlah 26 orang. Teknik pengambilan sampel menggunakan teknik random sampling. Teknik pengumpulan data menggunakan teknik tes. Tes yang digunakan menggunakan jenis tes uraian baik untuk mengukur keterampilan berpikir kreatif maupun untuk data tentang kemampuan pemecahan masalah. Berdasarkan hasil uji realibilitas tes semua butir berada pada kategori tinggi. Teknik analisis data menggunakan MANOVA dengan bantuan SPSS 23.00. Adapun uji prasyarat yang digunakan yaitu uji normalitas data, uji homogenitas data, dan uji multikolinieritas.Temuan penelitian menunjukkan bahwa baik secara terpisah maupun secara simultan kemampuan berpikir kreatif dan kemampuan pemecahan masalah siswa yang memperoleh pembelajaran dengan model pembelajaran berbasis proyek lebih tinggi dibandingkan dengan siswa memperoleh pembelelajaran dengan model konvensional. Model proyek juga memberikan dampak kuat dan penting terhadap kemampuan berpikir kreatif dan kemampuan pemecahan masalah matematika siswa sekolah dasar. Kesimpulannya bawah implementasi model pembelajaran berbasis proyek menjadi salah satu pilihan aternatif yang digunakan guru untuk kreativitas belajar matematika di sekolah dasar.
Kata Kunci: kemampuan berpikir kreatif; kemampuan pemecahan masalah; pembelajaran berbasis proyek

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Introduction

Higher order thinking skills (HOTs) oriented learning in Indonesia has not yet shown encouraging results. Including HOTs in mathematics learning at elementary schools (Asriani et al., 2023; Putri et al., 2024; Saraswati & Agustika, 2020). In terms of achievement, Indonesian students are still ranked low in the world. This issue is relevant to the results of a study conducted by the Organization for Economic Cooperation and Development (OECD) using broader global standards with the Program for International Student Assessment (PISA) test since joining this organization has not shown significant improvement, on the contrary, it has stagnan (OECD, 2019).

Mathematics is a component of knowledge that has a central role in developing the competencies needed in the 21st century. Understanding mathematics is central to the young generation's readiness to live in modern society. Wicasari and Ernaningsih (Saraswati & Agustika, 2020) explain that sharpening logic through learning mathematics is the same as train higher order thinking skills. As a basis for the development of modern knowledge and technology, mathematics also plays a role in advancing human thinking power. In various fields, this branch of knowledge is useful for solving problems until it is ultimately used as a standard that determines educational progress in a country (Pratama & Retnawati, 2018) Even though it is a focus in the K 13 curriculum content, its implementation has not been consistently implemented, where teachers focus on solving routine problems on mathematics including the lack of innovation in choosing learning methods for the formation of HOTS (Setiawati et al., 2019). Mathematics subjects provide the ability to think logically, analytically, systematically, critically, innovatively and the ability to collaborate. These subjects need to be taught from the basic education level (Widana, 2017). Through mathematics subjects, it is hoped that students will be able to apply its uses to everyday life.

However, the results of the PISA study show that where in the last 10-15 years the results of the PISA study show that performance tends to decline in terms of Literacy ability which is ranked 72nd out of 77 countries, Mathematics is ranked 72nd out of 78 countries, and Science is ranked 70th out of 78 countries, this makes Indonesia at rank 74 (Schleicher, 2018). The results of the PISA 2022 study show that almost no Indonesian students have the best performance in mathematics for levels 5 and 6 (OECD average 9%), only 18% of them are at level 2 (OECD average 69%). International mathematics literacy scores in PISA 2022 fell by 21 points on average. Indonesian score fell by 13 points, better than the international average, where as many as 82% of countries participating in PISA 2022 experienced a decline in scores in mathematics literacy compared to PISA 2018. (Kemendikbudristek, 2023; OECD, 2023).

That to achieve the goal of enjoyable learning a creative and innovative process is needed by choosing a learning model or approach that is able to guide students in solving problems based on high order thinking skills (HOTs). So that students' HOTs can develop, students need to be habbit activities that drill HOTs (Nuraini et al., 2022). In this case, students can not only remember and understand a concept, but students can analyze and synthesize, initiate and create a concept, the concept that has been understood can record in their long term memory (Al-Farisi et al., 2023; Arifin & Retnawati, 2017; Ndiung & Jediut, 2020).

Learning for elementary school students is a concrete operational learning fase, where the student's learning process should interact with real objects or real problem in daily life (Rohaendi & Laelasari, 2020). So, especially in mathematics learning in elementary school, learning must emphasize direct learning to develop their competencies, so that they are able to

understand mathematical concepts through learning by doing. In learning teachers are required to using media visual can make students to understand the material (Wardani et al., 2019; Zetriuslita et al., 2023). Facilitated learning must be HOTs-oriented for creative thinking skills and problem-solving abilities (Astuti et al., 2019; Munar et al., 2022; Utami et al., 2020). HOTs is a thinking ability that every student must have in solving mathematical problems. According to Thompson (Astuti et al., 2019), there are many activities that can be carried out with HOTs, namely (1) determining something; (2) do something to solve it; (3) contains a new object; (4) make predictions; (5) solve non-routine problems. In doing HOTs students must use complete, non-algorithmic thinking in solving problems, using different solving strategies. The HOTs concept comes from Bloom's Taxonomy, the cognitive domain is in a higher order, namely analyzing, evaluating, creating, and requiring mastery of the previous level (Teimourtash & YazdaniMoghaddam, 2017).

The facts show that mathematics learning in class experiences quite a lot of obstacles, including teachers not giving students the opportunity to solve problems, where students are more directed to solve routine problems, while paying less attention to solving non-routine problems. In line with Arends' opinion which states that in teaching teachers always demand students learn and rarely teach students how to learn, teachers also demand students solve problems, but rarely teach students how to solve problems (Fatwa et al., 2019). Learning that only focuses on numeracy skills does not support the problem-solving abilities (Maskur et al., 2020). Students tend to be used to learning and are given many types of questions. Considering that daily test questions, or grade promotion assessment questions are still in the realm of C1 to C3 only LOTs, there are C4 but not many. Not only does it provide HOTs type questions which are in the spotlight, but also the way students arrange or design how to answer the questions starting from making it known, being asked until being answered. HOTS's thinking ability is sufficient and the low ability to answer C6 cognitive domain questions is also a result of lack of practice in making plans for problem solving steps in the questions (Alfiatin & Oktiningrum, 2019).

HOTs is the ability to combine facts and ideas in the process of analyzing, transmitting to the creation stage in the form of providing an assessment of a fact that has been studied or being able to create from something that has been studied. The process of analyzing, evaluating and creating is part of the cognitive taxonomy created by Benjamin S. Bloom in 1956. In the end it was refined again by Anderson and Krathwohl (2001) into C1-remembering, C2-understanding, C3-applying, C4-analysis, C5-evaluating, and C6-creation. (Alfiatin & Oktiningrum, 2019; Saraswati & Agustika, 2020) explains that levels one to three are low-level thinking skills and levels four to six are HOTS. So, if viewed from the cognitive realm, HOTs is the ability to analyze, evaluate and create.

Creativity is an important aspect in dealing with various types of problems because it opens students' thinking horizons to seek fundamental understanding (Runisah et al., 2017). Creativity increases students' cognitive aspects as well as their awareness to evaluate and convey information critically (Changwong et al., 2018). It is further considered a High Order Thinking (HOT) skill, which consists of the components of fluency, delivery, and originality (Astutik et al., 2020; Sriwongchai, 2015; Yusof & Seman, 2018). Generally refers to the ease of generating several concepts in the creative process; equation relates to the ability to abandon old ways of thinking and accept new concepts or new paths, and originality involves the ability to generate ideas that would otherwise be impossible, predicted, unusual, or unique (Handayani et al., 2018).

Creative students are effective problem solvers. Its true that, mathematics classrooms aim to develop various skills so that students can complete their application in everyday life (Kızıltoprak & Köse, 2017). Therefore, as creativity increases, student achievement in mathematics will increase. The cognitive area is usually evaluated according to the Bloom's Taxonomy version ofrevised, namely students' ability to remember, understand, apply, analyze, evaluate and create certain knowledge (Morteza & Moghaddam, 2017). Assessment of student learning outcomes in problem solving abilities provides insight for teachers to make various decisions for future learning series (Zetriuslita et al., 2023).

A learning model that can increase students' creativity in solving mathematical problems is a project-based learning model (Nurfatanah et al., 2018). The characteristics of the project-based learning model are that students think about concrete problems, look for solutions, and work on projects in time to overcome problems (Ginting & Parmiti, 2023). In the PjBL model, students not only understand the content, but also develop students' skills on how to participate in society. Skills developed in PjBL include communication and presentation skills, organizational and time management skills, research and investigation skills, self-assessment and reflection skills, group participation and leadership skills, and critical thinking.

The implementation of the project-based learning model is important, especially in mathematics learning in elementary schools, considering that the formation of creative thinking skills and problem-solving abilities is not a priority scale. PJBL can provide teachers with the opportunity to manage learning in the classroom by involving project work that complex tasks based on very challenging questions and problems and guides students to design, solve problems, make decisions, carry out investigative activities, and provide opportunities students to work independently (Nuraini et al., 2022; Nurfiriyani, 2016). However, in this research the focus is more on the formation of HOTs in problem solving material about fractions in elementary schools which has been a problem for both teachers and students. This is supported by (Zubaidah et al., 2017) that one of the factors that helps in forming students' HOT in teaching model used by teachers. Research shows how useful guidance from teachers, for example by using scaffolding, supports student exploration in a student-centered learning atmosphere (Gita & Apsari, 2018). Therefore, it is very urgent to carry out research which aims to describe improving creative thinking skills and mathematical problem solving abilities by implementing the Project Based Learning model.

Research Method

This research was conducted at SDK Mano I, East Manggarai Regency using a quasi-experiment design with posttest-only group design (Creswell, 2014). The aim of this research is to describe the differences between the experimental group and the control group in creative thinking skills and mathematical problem solving abilities. The experimental group was presented with the PjBL Model, while the control group was presented with the conventional Learning Model. This research consists of three steps, namely pre-experiment, experiment, and post-experiment. The treatment was conducted in eight meetings, both in the experimental group and the control group, which was then completed with a post-test to evaluate students' creative thinking abilities and mathematical problem solving abilities. This research involved 53 fifth grade elementary school students who were selected using random techniques. Class V consists of two classes, namely class VA as an experimental class with 27 people and class VB as a control class with 26 people. Data were analyzed using descriptive and inferential statistical analysis.

Data on students' creative thinking abilities and mathematical problem solving abilities were collected using essay tests; each consisting of 5 items. The creative thinking skills rubric was adapted from Bosch (Moma, 2015) using a scale of 0-4. The contents of the test instrument measuring mathematical problem solving abilities were validated by 3 experts in the field of mathematics learning and checked using the content validity ratio (CVR) developed by Lawshe (Ndiung et al., 2021).

The instruments used in this research have been validated and their reliability has been verified empirically. The reliability coefficient of the thinking skills rubric is calculated based on inter-rater reliability. The reliability coefficient of 0.84 is included in the high category, and the reliability coefficient of learning outcomes of 0.81 was tested using the Cronbach's Alpha formula. Data analysis used Multivariate Analysis of Variance (MANOVA) which was preceded by an assumption test, namely the normality test of data distribution, homogeneity test of data group variance, and multicollinearity test. Data analysis used the Statistical Package for Social Sciences (SPSS) for window version 23.0 program

Results and Discussion

Based on the results of data analysis, research findings, the results of descriptive statistical analysis of the results of the HOTs posttest on student mathematics can be presented in Figure 1.

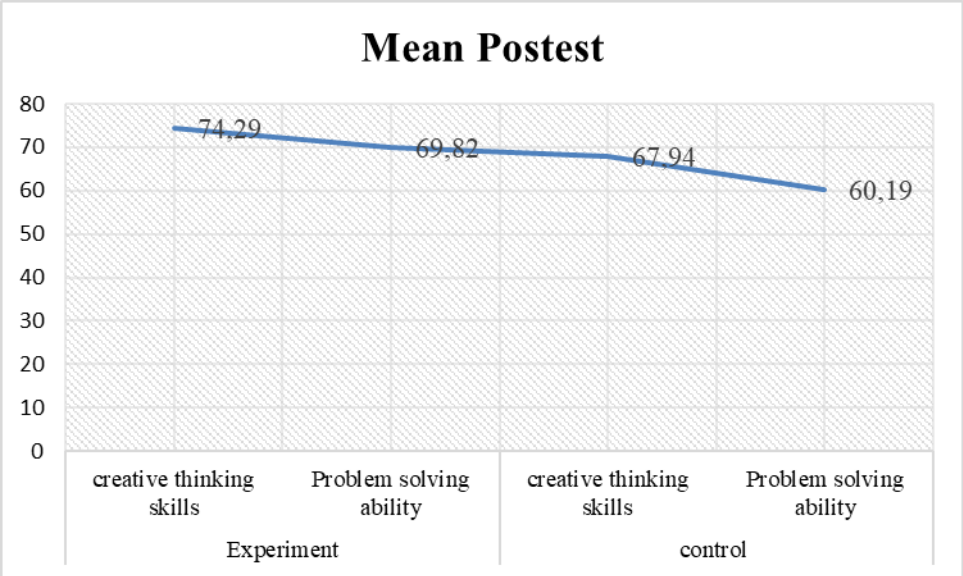

Figure 1. Recap of Descriptive of Postest Data

Based on the data in the Figure 1 above, it can be concluded that the average creative thinking ability and average mathematical problem solving ability of students who receive learning using the PjBL model is higher than students who receive mathematics learning through conventional teaching models.

From the existing data, proceed with the assumption test, in this case the data distribution normality test, the data group variance homogeneity test, and the multicollinear test. The results of the assumption test with the help of the SPSS 23.0 program that normality has a Kolmogorov sig value exceeding 0.05. Therefore, it can be said that all groups of students' creative thinking skills scores and mathematical problem solving ability scores in this study came from a normally distributed population. Then the homogeneity test of the variance

of the creative thinking skills data and the students' mathematical problem solving ability data was carried out using the Box's covariance matrix equality test to test the homogeneity of variance simultaneously, namely the creative thinking skills group and the students' mathematical problem solving ability group.

Then a multicolinearity test was conducted to see the corellation between the variables of creative thinking ability and students' mathematical problem solving abilities, both of which are dependent variables, and to ensure that the two can be used as different criteria so that there is no overlap. Multicollinearity testing is carried out based on the Variance Inflation Factor (VIF) value and tolerance value. The results of the multicollinearity test analysis show that the VIF value is less than 10. Thus, it can be said that the variables creative thinking ability and mathematical solving ability do not experience multicollinearity so they can be used as different criterion variables. In this case the two variables can be used as criterion variables separately and simultaneously.

With the results showing no multicollinearity, the procedure continued with hypothesis testing using Multivariate Analysis of Variance (MANOVA). Hypothesis testing was carried out using inferential analysis assisted by the SPSS version 23.0 application program. A recap of the results of MANOVA analysis of data on students' creative thinking abilities and mathematical problem solving abilities can be seen in Table 1.

Tabel 1. Recap of Manova analyze

Multivariate Tests[b]						
Effect		Value	F	Inter Group df	Within Group df	Sig.
Intercept	Pillai's Trace	.991	5682.327[a]	2.000	51.000	< 0.001
	Wilks' Lambda	.009	5682.327[a]	2.000	51.000	< 0.001
	Hotelling's Trace	115.966	5682.327[a]	2.000	51.000	< 0.001
	Roy's Largest Root	115.966	5682.327[a]	2.000	51.000	< 0.001
PjBL Learning Model	Pillai's Trace	.260	17.195[a]	2.000	51.000	< 0.001
	Wilks' Lambda	.740	17.195[a]	2.000	51.000	< 0.001
	Hotelling's Trace	.351	17.195[a]	2.000	51.000	< 0.001
	Roy's Largest Root	.351	17.195[a]	2.000	51.000	< 0.001

a Exact Statistic

b Design: Intercept + Learning Model

Based on the data in Table 1 above, it is found that the F Wilks' Lambda value = 17, 195, and sig < 0.001 with a sig value < 0.05, it can be said that simultaneously the creative thinking abilities and mathematical problem solving abilities of students who receive learning using the Project Based Learning model are higher than students who receive mathematics learning through conventional learning models. The PjBL learning model also has a strong and important impact on students' creative thinking abilities and mathematical problem solving abilities.

The findings of this research are in line with research (Noviyana, 2017) that there is an influence of the Project Based Learning model on the creative thinking abilities in mathematics of class VIII even semester students at SMP Negeri 3 Bandar Lampung. The findings of this research are also supported by research (Anggraini & Wulandari, 2020) which shows that the project based learning (PjBL) learning model is able to have an influence on increasing student activity in learning. This research also really supports students to understand more deeply the material presented. Student activity can also influence learning outcomes in the end. So that the learning process that occurs will not be monotonous and

boring, it will be easier for students to understand the material to be studied with the various activities implemented.

The implementation in the experimental class is that the project based learning model in this research uses six steps that need to be passed so that students' thinking skills and mathematical problem solving abilities can be formed (Nuraini et al., 2022), namely (1) Determining the Project. At this stage, the presentation of the topic by the teacher is then followed by the activity of asking questions by students regarding how to solve the problem. (2) Planning steps for project completion. The teacher groups students according to project creation procedures. In the competency to solve problems regarding fractions, students show enthusiasm through student worksheets which are completed in groups. Then students solve problems through discussion activities and even directly experience problems in society related to fractions. (3) Preparation of project implementation schedule. At this stage, determine the steps and schedule between the teacher and students in completing the project. After meeting the deadline, students can prepare steps and a schedule for its realization; (4) Completion of the project with teacher facilities and monitoring. Monitoring carried out by teachers regarding student activity when completing projects as well as realizations made in solving problems. Students carry out realization according to the predetermined project schedule; (5) Preparation of reports and presentation/publication of project results. Teachers and students hold discussions in monitoring the realization made by students based on work results and products. The discussions carried out are used as reports as material for presentation to other people; and (6) Project evaluation. At this stage, the teacher provides direction on the project presentation process, then reflects and summarizes in general what has been obtained through the teacher's observation sheet.

The findings of this research are in line with previous relevant research regarding the influence of the Project Based Learning model on creative mathematical thinking skills (Arviani et al., 2023; Widiastuti et al., 2023). The findings of this research are also supported by other research which shows that the project based learning (PjBL) learning model is able to have an influence on increasing student activity in learning (Anggraini & Wulandari, 2020; Sumarni & Kadarwati, 2020). This research also really supports students to understand more deeply the material presented. Student activity can also influence learning outcomes in the end. So that the learning process that occurs will not be monotonous and boring, it will be easier for students to understand the material to be studied with the various activities implemented. Likewise, several other studies that support the findings of this study show that the implementation of PjBL learning based on simple teaching aids can be used to develop critical thinking skills and creative thinking skill (Maskur et al., 2020; Vonny et al., 2023; Zetriuslita et al., 2023).

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The implication of this study is that Project Based Learning (PjBL) model has a huge positive impact on students' creative thinking skills and mathematical problem solving abilities, especially in 21st century education amidst uncertain global competition. Each step of PjBL syntax plays an important role in forming students' analytical and evaluative capacities. By following prescribed activities, students are consistently trained to analyze and research information before accepting it. Critical thinkers question and criticize assumptions, seeking to establish the validity and reliability of acquired knowledge. PjBL creates an environment that fosters these skills by engaging students in real-world problems. This approach encourages students to reflect on their own assumptions, explore diverse perspectives, and engage in thoughtful inquiry. By challenging preconceptions, students improve their critical thinking, creative and problem-solving abilities. These skills are invaluable in the 21st century, equipping students with the tools necessary to thrive in a complex and competitive global landscape. Problem Based Learning not only facilitates the acquisition of subject specific knowledge but also fosters the critical thinking skills necessary for learning to survive in the future.

Meanwhile, the limitation of this research is that the HOTs constructed in the test are only at level C4 in fraction material. Thus, teachers must be able to facilitate learning activities by increasing practice in constructing test questions at levels C5, and C6. Apart from that, students are given space to be able to express themselves to solve problems by communicating their ideas and thoughts with HOTs problem solving exercises.

Conclusion

The project-based learning model is a learning model with creative techniques that can guide students to be able to solve unusual problems involving realistic problems using projects that support creativity and products that can be produced by students. The results of the research show that the creative thinking abilities and mathematical problem solving abilities of students who use the project learning model are higher than students who learn mathematics through conventional learning models, both separately and simultaneously. Thus, it can be said that project-based learning can be used by elementary school teachers in mathematics learning to form Higher Order Thinking Skills (HOTS) abilities in fifth grade students, especially in fractions. Therefore, future researchers can prove its effectiveness in other subject matter or in other subjects in elementary schools by focusing on question construction at levels C5 and C6.

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