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The Use of Folding Paper to Support Students' Understanding of Summation and Subtraction

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A R T I C L E I N F O

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A B S T R A K

Pecahan merupakan bagian dari materi matematika yang sulit dibelajarkan oleh guru sekolah dasar yang mengakibatkan peserta didik belum mampu memecahkan masalah terkait konsep pecahan dan operasinya. Penelitian ini bertujuan meningkatkan hasil belajar dan keaktifan peserta didik dalam menyelesaikan operasi hitung penjumlahan dan pengurangan pecahan menggunakan kertas lipat. Penelitian ini adalah penelitian tindakan kelas dengan menggunakan desain Kemmis & McTaggart. Subjek penelitian ini melibatkan peserta didik kelas V tiga sekolah dasar dengan total subjek penelitian 170 orang. Teknik pengumpulan data menggunakan teknik tes dan teknik observasi. Instrumen tes yang digunakan adalah 8 butir soal bentuk uraian untuk mengukur hasil belajar matematika sementara observasi dilakukan oleh observer menggunakan lembar pengamatan untuk mengukur keaktifan peserta didik dalam pembelajaran menggunakan kertas lipat. Teknik analisis data yang digunakan adalah teknik deskriptif kuantitatif dengan kriteria ketuntasan klasikal minimal 85% memperoleh nilai 75 untuk hasil belajar dan keaktifan peserta didik minimal kategori aktif. Berdasarkan pelaksanaan pembelajaran selama dua siklus, hasilnya menunjukkan bahwa hasil belajar peserta didik mengalami peningkatan dari siklus I ke skilus II dengan kriteria ketuntasan melampaui ketentuan yang ditetapkan. Demikian halnya data keaktifan peserta didik mengalami peningkatan dari kategori cukup aktif pada siklus I menjadi kategori sangat aktif pada siklus II. Dengan demikian dapat dikatakan bahwa melalui penggunaan kertas lipat mampu meningkatkan keaktifan dan hasil belajar peserta didik pada operasi hitung penjumlahan dan pengurangan bilangan pecahan. Sehingga disarankan agar guru sebagai inovator memiliki kesadaran untuk berinovasi dalam konten pengetahuan materi dan menggunakan alat peraga dalam pembelajaran.

A B S T R A C T

Fractions are part of mathematical material that is difficult for elementary school teachers to teach which results in students not being able to solve problems related to the concept and arithmetic operation of fractions. The aim of this study is to improve the learning outcomes and the activeness of students in computing the addition and subtraction of fractions using folding paper. This research is a class action research using the design of Kemmis & McTaggart. The subjects of this study included students in Grade V of three elementary schools, with a total of 170 research subjects. The data were collected by using test and observation techniques. The test instrument used was eight items in the form of descriptions to measure mathematics learning outcomes, while observations were made by the observer using observation sheets to measure student activity in learning using folding paper. The data analysis technique used is quantitative descriptive technique with a minimum of 85% classical completeness criteria with a score of 75 for learning outcomes and the activeness of students at least in the active category. Based on the implementation of two-cycle learning, the results show that the learning outcomes of students have improved from cycle I to cycle II, with criteria for completeness exceeding the permitted requirements. Similar to the student activeness data increased from the fairly active category in the first cycle to the very active category in the second cycle. Thus it can be said that the use of folding paper can enhance the students' activeness and learning outcomes in the computation of the addition and subtraction of fractions. So it is suggested that teachers as innovators have the awareness to innovate in material knowledge content and use teaching aids in learning.

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1. Introduction

Mathematics education is a problem that is often discussed in the world of education to evaluate the failure of learners to obtain maximum learning achievement. Learning that only prioritizes logic and computing ability seems to ignore creativity and seems to be considered unimportant in the learning process. It is supported by experts opinion (Fatwa, Septian, & Inayah, 2019; Maskur et al., 2020) that learning that focuses only on counting skills does not support the formation of problem-solving capabilities. Nowadays, mathematics learning must be oriented to the skills needed in 21st-century education, namely *Communication, collaboration, critical thinking* and *creativity* as a new standard that students need to be able to think critically and overcome the problems, be able to communicate and collaborate, be able to think creatively and create innovations (Partnership for 21st Century Learning, 2015; Saavedra & Opfer, 2012).

Facts show that until now, portraits of academic achievements of Indonesian students have not demonstrated sufficient predicates. As the 2018 *Program for International Student Assessment* (PISA) study followed by 79 countries, Indonesian students are ranked unsatisfactory, which tends to stagnate in the last 10-15 years. The results showed that Literacy ability is ranked 72 out of 77 countries, Mathematics is ranked 72nd out of 78 countries, and Science is ranked 70th out of 78 countries; this makes Indonesia ranked 74th, which is precisely lower than the survey results in 2015 (OECD, 2019). At the same time, content standards are designed so that learners can think critically and analytically following international standards conducted by reducing irrelevant material and deepening and expanding relevant material for learners. The assessment standards are carried out by gradually adapting the models of global standard assessment. Assessment of students' learning outcomes should focus more on high-level thinking skills (Kemendikbud, 2017; Simalango, Darmawijoyo, & Aisyah, 2018).

In order to achieve an effective and efficient learning concept, there needs to be a reciprocal relationship between learners and teachers to achieve a common goal, provide a safe learning environment, encourage student response, have mastery of learning content, monitor learners' progress and learning feedback, and build positive relationships. This is in line with Vygotsky's view that learning occurs when learners work on tasks that have not been learned but that the tasks are within the *zone of proximal development* (ZPD) of learners (Rohaendi & Laelasari, 2020; Shabani, Khatib, & Ebadi, 2010). Also, cognitive development based on Piaget theory of elementary school students is in a concrete operational phase. In the presentation, the concept needs to be assisted by media or props that can better understand students. As well as (Ardana, Wisna Ariawan, & Hendra Divayana, 2017) shows that for abstract concepts, learning must be done meaningfully, one of which is to pay attention to the characteristics of learners following the level of cognitive development of Jean Piaget.

Thus, for the learning of fraction counting operations is now a problem for teachers in presenting and students have difficulty understanding it, it needs to be pursued through props that are easy to manipulate not to confuse students. This is important, considering that most students still make many mistakes and have difficulty understanding the concept of fractions and their counting operations. This is in line with the findings of his research (Suryowati, 2015) which showed that the mistake made by the subject was a conceptual error, in which the issue did not yet fully understand the fractions represented on the number line. Besides, the subject also makes an application error. The subject understands the concept but cannot describe it on the number line. Similarly, the findings of his research (Nuraini, Suhartono, & Yuniawantika, 2016) showed that in performing the operation to calculate the summation and reduction of fractions of learners still make mistakes including procedure errors, concept errors, errors in misinterpreting instructions, errors due to carelessness, application errors, and learning errors.

The use of props at the initial teaching of fraction counting operations is essential to please the learners. This is in line with his opinion (Amir, 2015) that mathematics is an art, and if taught interestingly, it will be felt delightful. Previous researchers have widely made the use of props in teaching the concept of fractions and its operation as well as (Pajarwati, Pranata, & Ganda, 2019) shows that there has been a significant improvement to students' understanding after using fractional card media in learning to compare fractions. Similarly (Indriani, 2018), in the findings of his research showed that students are enthusiastic in following the learning of fractional number through fractional blocks. Likewise (Rahmawati, 2011) in her research results, showed that a series of activities that have been done help improve students' understanding of the learning of addition and reduction of fractions. Also, (Yasa, Suastika, & Wahyu Ningtyas, 2020) showed that the development of the disassembly model could be used by teachers in the learning process of summing fractions to make it more exciting and enjoyable. Meanwhile, his research (St. Hasmiah Mustamin, 2018) shows that the difficulties students experience in solving fractional material problems can be overcome by using props that can motivate students to follow lessons, improve knowledge and mastery.

The various research findings outlined by previous researchers related to the use of props in the study of summation and fractional reduction operations have not explicitly explained how the use of media or props used could be used simultaneously besides and subtraction operations. Besides, there is no explanation of whether the props they use apply to the addition and subtraction operations of fractions on different-named fractions and mixed fractions. Meanwhile, folding paper (using white and coloured HVS A4/F4 paper) can present at once in planting the concept of counting operations and subtraction of fractional numbers). Also, folding the paper can be determined by summing and subtracting unequal fractions and mixed fractions practically. On that basis, research on the use of folding paper props in the operation of counting additions and fraction reduction is fundamental in addition to practical use by students. It can also educate teachers in schools to use props, considering by folding the paper, participants do not need to do the equalization of denominators and/or determine the KPK of two or more numbers. If these props are well used then, it will undoubtedly impact improving the learning outcomes and activeness of learners in learning and be able to make the learning meaningful and fun and stored long in the memory of the learner. This is supported by the findings of his research (Kania, 2018) shows that the concept of fractional students who use manipulative media is better than conventional classes. In addition, students have a positive attitude towards manipulative objects of mathematical learning and a positive attitude towards understanding fractional concepts. Similarly, (Wahyu, Amin, & Lukito, 2017) shows that the use of motivation cards can improve learners' understanding in the operation of calculating fraction division, especially in the division of integers with fractional numbers.

2. Method

This research was classroom action research. This class action research was conducted following the research steps of Kemmis & McTaggart model, which started from the planning, implementation, observation and reflection phase aimed at (Kemmis, McTaggart, & Nixon, 2014). The procedure for conducting this research, outlined in Chart 1 follows.

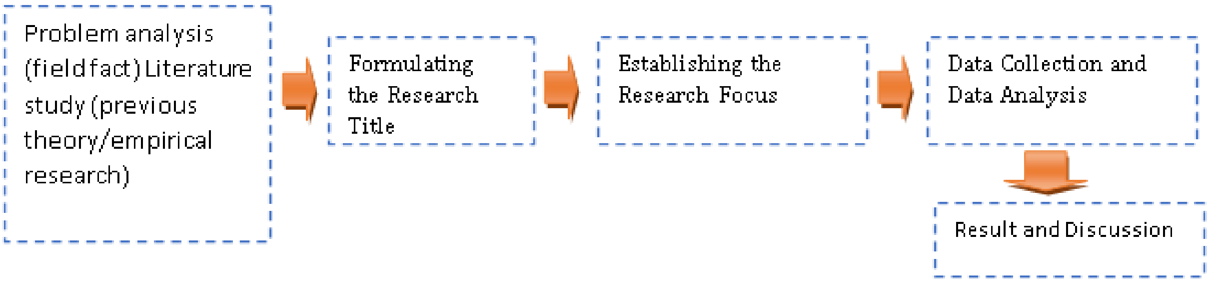

Figure 1. Research Flowchart

The study involved collaborators because the researchers collaborated with teachers at the school where the study was located. The subjects of this study were students of grade V elementary school of 170 people spread across three elementary schools in Ruteng Subdistrict, Manggarai Regency with details of SDI Rai numbering 53 people, SDK Benteng Wake numbering 56 people and SDI Wae Belang numbering 61 people.

To obtain research data, researchers used test and observation techniques. The test technique was used to obtain data on the results of learning mathematics learners in the operation of counting the summation and subtraction of fractions with the test instrument used were the test questions form a description of 8 points of questions that have been validated and declared valid with a coefficient of Reliability 0.81 in a very high category. Meanwhile, to obtain data on the activeness of learners during learning, observation sheets containing indicators of student activity during the learning process start from the predecessor activities, core and cover consisting of 8 indicators and 15 statements. The indicators of activeness observation of learners such as 1) solve the problem; 2) ask questions; 3) answer the teacher's question; 4) skilled in using props; 5) discuss in groups; 6) present/report the results of the discussion; 7) respond/give an opinion during the discussion; and 8) record the teacher's explanation and the results of the discussion. Observation activities were carried out by observers who were teachers in the school where the research was based regarding the observation guide. The one who acted as a grade V teacher equipped by a team of researchers in folding paper one week before the study was conducted. The implementation of actions was carried out following the learning schedule of the school. The classroom situation continues to occur naturally so that the success of the action was determined by the success of the use of props rather than influenced by other factors

Data were analyzed using quantitative descriptive analysis. The descriptive quantifiable analysis was used to analyze data on learning outcomes and observations to see their activity level. The criteria for completing minimal learning results are at least 85% of subject obtain a minimum score of 75. Meanwhile, to know the success rate on the activeness of learners in learning with a score of ≥ 75%..

3. Result and Discussion

Results

The study began with a pre-action activity in which researchers gave preliminary tests to determine students' initial abilities before being given action. This initial test was conducted for the research subjects, namely students of class V SDI Rai numbering 53 people, SDK Benteng Wake numbered 56 students and SDI Wae Belang numbered 61 people. The test results obtained that the mean or average value of consecutive learning results is SDK Benteng Wake 38.4, SDI Wae Belang 37, 9, and SDI Rai 35.8. The data of the pre-act results can be seen in Figure 1 below.

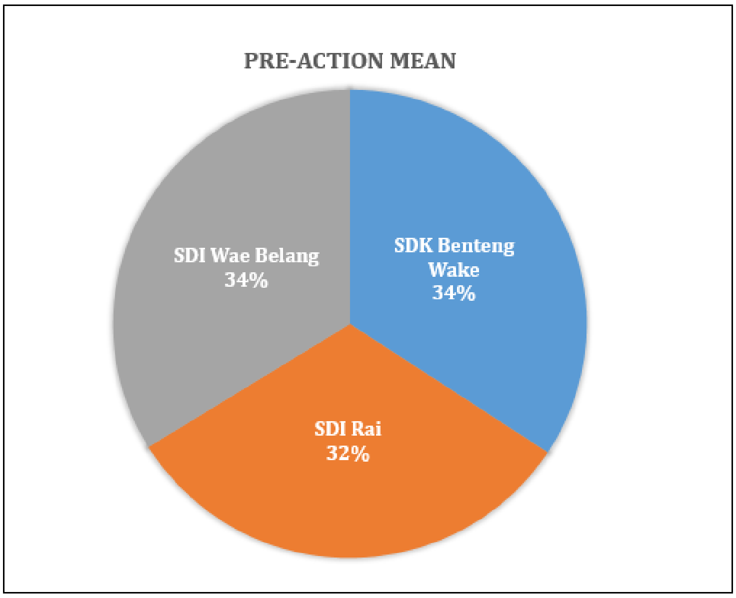

Figure 2. Recapitulation of Pre-Action Result

Based on the data in Figure 2 above, the ability of learners to solve fractional problems for the three schools sampled by the study had an average difference that did not differ significantly. It can be said that the condition of the subjects of the three schools was almost the same. Further action was given to the material on the summing and subtraction operations of different-named fractions. The implementation of this research refers to the learning tools that have been prepared, namely the learning implementation plan, student worksheets, observation sheets, and test questions. The data of observations on the activeness of students during the teaching and learning process in Cycle I and Cycle II conducted by three observers with details of one observer for one research school using observation sheets can be seen in Figure 3 below.

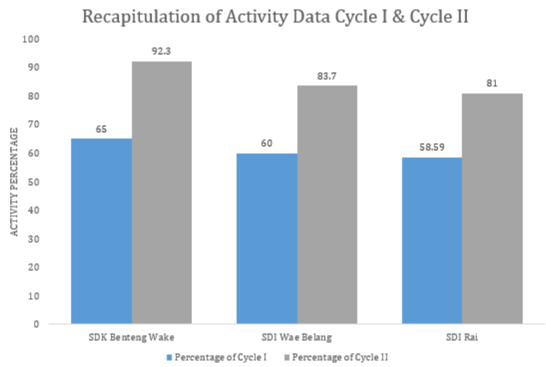

Figure 3. Recapitulation of Activity Data Cycle I & Cycle II

Based on the data in Figure 3 above, in Cycle I, students' activeness during the teaching and learning process (PBM) was in the active category for SDK Benteng Wake while for SDI Rai and SDI Wae Belang were in the category of quite active. Meanwhile, in Cycle II, there was a very significant increase for students' activeness data during PBM in three research schools each in the very active category. Furthermore, the data on the results of learning mathematics in Cycle I and Cycle II can be seen in Figure 4 below.

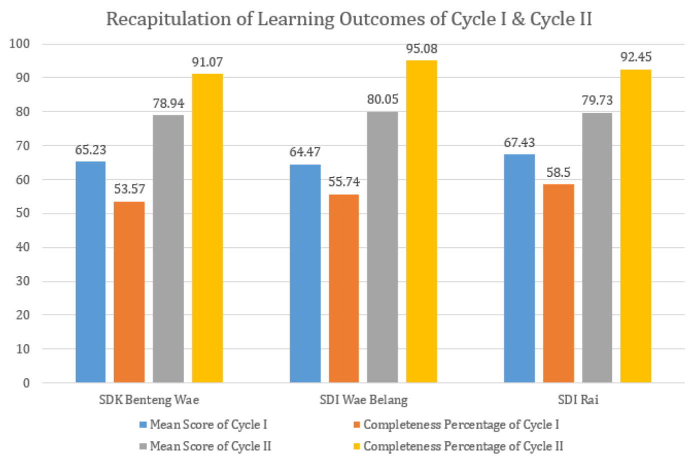

Figure 4. Recapitulation of Learning Outcomes of Cycle I & Cycle II

The data in Figure 4 above showed that there was an increase in the score of students' math learning results from Cycle I to Cycle II followed by a percentage of completion that exceeds the established minimum required standard. In Cycle I, each classical completion research school is still less than 60%, while it reaches more than 90% in Cycle II.

Discussion

Based on the data of the study results, there was an increase in the activeness of students in the learning process from Cycle I to cycle II as evidenced by the rise in activeness score with the category of active enough to be a very active category. This was indeed inseparable from the role of folding paper props that are effectively able to guide interactive learning activities. Similarly, the study results showed an increase in the classical completion percentage cycle of less than 60% in Cycle II reached above 90%. The success of implementing this action was also inseparable from the role of mentoring teachers and media, or folding paper props can overcome difficulties in understanding fraction counting operations. This was in line with the findings of his research (Mulyani, Suarjana, & Tanggu, 2018; Yasa et al., 2020) showed that through the use of props and contextual concept emphasis in learning and paying attention to student development using evaluation results at the end of learning can improve student learning outcomes.

This finding was in line with Jerome Bruner's theory of learning which says that for learning to develop the intellectual skills of learners in realizing a knowledge (e.g. a mathematical concept), the subject matter needs to be presented by paying attention to the stage of cognitive development/knowledge of learners for that knowledge to be internalized in the mind (cognitive structure) of the person. According to Bruner, the internalization process will occur in earnest (which means the learning process occurs optimally) if the knowledge learned in three-stage models is the enactive stage model, the iconic stage model, and the symbolic stage model. Bruner's opinion supports Jean Piaget's theory that the human thought process gradually developed from concrete intellectual thinking to abstract (Ardana et al., 2017). In this case, elementary school-age learners (7-12) years were in the concrete operational phase, and knowledge was presented from the concrete stage to the abstract stage.

The activeness of learners in cycles I and II showed excellent improvement. Their activities demonstrated this during learning through group discussions of students able to perform well. Their Cycle I looks rigid in folding paper; instead, Cycle II looks skilled at using folding paper and can determine the result of summing and subtracting fractions perfectly without equating the denominator and/or determining the KPK of two or more numbers. Their enthusiasm in presenting the results of group discussions and doing good cooperation by helping other friends who have difficulty understanding fraction counting operations using folding paper props. Part of the discussion group was done by paying attention to the variety of students' abilities to interact with each other and communicate their ideas or ideas about problem-solving by mutual respect for differences of views so that more capable learners can help underprivileged learners. This was in line with Vygotsky's ZPD concept of saying that ZPD was a zone where learners cannot complete challenging tasks to master independently but can be mastered with guidance and assistance from adults or more skilled learners (Christmas, Kudzai, & Josiah, 2012). In this case, ZPD as a distance between the actual level of development shown in the ability to solve problems independently and the level of potential developmental ability shown in problem-solving skills with the help of adults or working with more capable peers (Siyepu, 2013).

Here, the teachers acted as *scaffolding,* and the teachers reduced their assistance until the students can be independent and understand for themselves. Through learning with peer tutors, students can exchange ideas to solve complex problems to produce or draw conclusions and become knowledgeable (Rohaendi & Laelasari, 2020; Sze Yeng & Hussain, 2010). As Kimble followed (Hergenhahn & Olson, 2012), learning is a relatively permanent change in behaviour or potential behaviour derived from experience. This process refers to Vygotsky's theory of constructivism. Learning is best when a student can relate what he learns in class to the environment and create meaning from different experiences (Zain, Rasidi, & Abidin, 2012). In this case, learners should be given habituation in learning behaviours that can generate learning motivation to not get discouraged. Thus, if students were always given space to solve problems in their way, it is impossible for them to solve math problems correctly. The numeration ability profile of high-skilled elementary school students in solving math problems capable and correct in using a variety of numbers or symbols related to basic mathematics to solve problems in various contexts of daily life (Maulidina, 2019).

Interactive learning activities connecting realistic problems with the concept being studied can help learners store knowledge in long-term memory. As stated by (Setyawan, 2020) students' learning activities on concrete media-assisted mathematics learning can improve students' math learning activities and outcomes. Through contextual and realistic-based problems oriented to non-routine problem-solving capabilities relevant to the understanding of mathematical connection capabilities. Here, students can connect between concepts learned with other prerequisite knowledge that has been owned (Ndiung & Nendi, 2018). Besides, students can avoid mistakes in solving concepts or math problems categorized as difficult though (Sennen, Ndiung, & Supardi, 2016). Also, (Ndiung & Jediut, 2020; Sudarman, 2017) suggests that it is necessary to involve story problems to direct skilled learners to solve HOTS-oriented problems in solving math problems. Thus, teachers should get rid of learners early on introduced problems that were applicative in daily life that are poured in the forms of non-routine story problems and instill a good and positive impression on the story questions as a type of fun and interesting questions so as to solve high-level thinking questions.

4. Conclusion

Based on the exposure of the results data and discussion can be concluded that the activeness of students in using folding paper shows an increase. In Cycle I, learners still look awkward folding paper and folding the paper sizes disproportionately. On the contrary, in cycle II, the learners have shown a very vigorous activity appointed by courage in expressing ideas and ideas and determining the area of the result of how to fold the paper. The criteria for the activeness of the students in this study were very active. Data from the pre-find study, Cycle I and Cycle II showed improvements in Cycle I. The learners had not demonstrated the ability to solve the problem of summing different fractions. Meanwhile, Cycle II has shown very satisfactory learning results according to the standards of completion and means the score individually and classically has exceeded the specified standard. Thus, folding paper can increase the activeness of learners in learning, which ws shown by the very high enthusiasm of learners during the learning process that impacts improving the results of mathematics learning. Based on the findings of this study, it was recommended that teachers as innovators have the awareness to innovate in the content of material knowledge and use props in learning.

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