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## The Effect of Interactive Learning Media Phet Simulation on the Ability to Understand Mathematical Concepts and Learning Motivation of Fourth Grade Students of SDIT Marhamah Solok Selatan

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### ABSTRACT

This study was motivated by the low mathematical concept understanding and learning motivation of fourth-grade students at SDIT Marhamah Solok Selatan, with only 41.5% achieving the Learning Objective Achievement Criteria (KKTP). This study aims to analyze the effect of PhET Simulation interactive learning media on students' mathematical concept understanding and learning motivation in the material plane area. A quantitative approach with a quasi-experimental method and Posttest Only Control Group Design was employed. The research sample consisted of 60 fourth-grade students of SDIT Marhamah Solok Selatan who were divided into an experimental class and a control class. Data were collected through a concept understanding test and a learning motivation questionnaire that has been declared valid and reliable. The results of the study showed that the average ability to understand mathematical concepts of the experimental class (81.27) was higher than the control class (70.93). The t-test and MANOVA showed a significant value of 0.000 ( $p < 0.05$ ), so it can be concluded that the interactive learning media PhET Simulation has a positive and significant effect on the ability to understand mathematical concepts and learning motivation of fourth grade elementary school students.

## 1. Introduction

Mathematics is a subject that plays a strategic role in developing students' logical, analytical, critical, creative, and systematic thinking skills (Jannah et al., 2024). Besides serving as a foundation for mastering science and technology, mathematics is also a means of developing problem-solving skills needed in everyday life (Erika Setiowati et al., 2024). Therefore, mathematics learning in elementary schools is not only directed at the ability to perform calculations, but also at developing a deep

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conceptual understanding so that students are able to relate various mathematical concepts to real situations (Anggraini et al., 2026) . Conceptual understanding is the main foundation in mathematics learning because it determines students' ability to apply their knowledge to solve various problems appropriately (Saputra, 2024) . Conversely, low conceptual understanding will cause students to only memorize formulas without understanding the meaning or relationships between the concepts being learned.

Mathematics learning at the elementary school level is ideally implemented through an active, meaningful, contextual, and student-centered process (Widiani & Soepudin, 2025) . Teachers not only act as conveyors of information, but also as facilitators who create learning experiences so that students can construct their own knowledge through exploration, discussion, observation, and problem-solving activities. Such learning allows students to gain more meaningful learning experiences while improving higher-order thinking skills. According to (Gusmarlia, 2025) mathematics learning should be designed to develop logical thinking skills and provide opportunities for students to build conceptual understanding through concrete learning experiences. This approach is in line with the characteristics of elementary school students who are still at the concrete operational stage and therefore requires learning media that can visualize abstract concepts.

However, the condition of mathematics learning in Indonesia still faces various challenges. The 2022 Program for International Student Assessment (PISA) results show that Indonesian students' mathematical literacy skills remain below the average for OECD countries (Putrawangsa & Hasanah, 2022) . These findings indicate that most students still experience difficulty understanding mathematical concepts and applying them to contextual problem-solving. This indicates that the ongoing learning process has not yet fully developed students' conceptual thinking skills.

This problem was also found at SDIT Marhamah Solok Selatan. Based on initial observations and interviews with fourth-grade teachers, mathematics learning is still dominated by lectures, practice problems, and the use of textbooks as the primary learning resource. Learning activities tend to be one-way, resulting in students receiving more information than building knowledge through direct learning experiences. As a result, students have difficulty understanding basic mathematical concepts, particularly the area of plane figures. Most students simply memorize formulas without understanding the underlying concepts, resulting in difficulties when faced with story-based problems or contextual problems.

The results of the daily score analysis further reinforce this condition. Of the 58 fourth-grade students consisting of classes IV Jeddah 1 and IV Jeddah 2, only 24 students (41.5%) have achieved the Learning Objective Achievement Criteria (KKTP), while 34 students (58.5%) have not reached the set standard. The percentage of KKTP achievement in class IV Jeddah 1 was 45%, while in class IV Jeddah 2 only reached 38%. These data indicate that more than half of the students still have low mathematical conceptual understanding abilities, so learning innovations are needed that can help students understand concepts more deeply. In

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addition to low conceptual understanding, observations also show that student learning motivation is still relatively low. Many students appear passive during learning, lack enthusiasm for participating in learning activities, easily lose concentration, and lack confidence when asked to solve mathematical problems. This condition indicates that the success of mathematics learning is not only influenced by cognitive aspects, but also by affective aspects, especially learning motivation. Highly motivated students tend to be more active, persistent, and resilient in the face of learning difficulties than those with low motivation. Therefore, efforts to improve the quality of mathematics learning need to be directed not only at improving conceptual understanding but also at building students' motivation through engaging, interactive instruction that is tailored to their developmental characteristics.

Various efforts have been made to improve the quality of mathematics learning, one of which is through the use of technology-based learning media. Interactive learning media can help students visualize abstract concepts more concretely, making them easier to understand (Irma Maulidia & Ibnu Muthi, 2025). One such media is PhET Simulation, an interactive learning media developed by the University of Colorado Boulder (Listiyoningrum et al., 2024). This media provides simulations that allow students to explore, observe, and manipulate objects directly, making learning more active, engaging, and meaningful. The use of PhET Simulation is in line with constructivism theory, which emphasizes that knowledge is built through direct learning experiences (Zaujaha et al., 2026).

Several previous studies have shown that PhET Simulation is able to improve learning outcomes, conceptual understanding, and student learning motivation because it presents interactive visualizations and provides direct feedback to users (Ulfia & Wahyuni, 2025). However, most research still focuses on junior high and senior high school levels, as well as science subjects. Research specifically examining the effect of PhET Simulation on elementary school students' mathematical conceptual understanding and learning motivation, particularly on the area of plane figures in fourth grade, is still relatively limited. This situation indicates a research gap *that* needs further study.

In addition, this study has novelty *because* it tests the effect of PhET Simulation simultaneously on two variables, namely the ability to understand mathematical concepts and learning motivation of elementary school students in the context of implementing the Independent Curriculum. The use of this media is expected to be able to create learning that is more student-centered, interactive, and in accordance with the developmental characteristics of elementary school students. Based on this description, this study aims to analyze the effect of PhET Simulation interactive learning media on the ability to understand mathematical concepts and learning motivation of fourth-grade students of SDIT Marhamah Solok Selatan. The results of the study are expected to be an alternative for teachers in developing mathematics learning that is more innovative, effective, and able to improve the quality of the process and learning outcomes of students.

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## **2. Methodology**

### ***Research Subjects***

This study uses a quantitative approach with a Quasi Experimental Design using a Posttest Only Control Group Design. The study was conducted at SDIT Marhamah Solok Selatan in the odd semester of the 2026/2027 academic year. The study population consisted of 60 fourth-grade students, all of whom were sampled using a total sampling technique. The sample consisted of two classes, namely fourth-grade Jeddah 2 as the experimental class that received learning using the interactive learning media PhET Simulation, and fourth-grade Jeddah 1 as the control class that received conventional learning. The independent variable in this study was the use of interactive learning media PhET Simulation, while the dependent variables included the ability to understand mathematical concepts and student learning motivation.

### ***PhET Simulation Implementation Procedure***

The experimental class was taught mathematics on the area of a plane figure using the interactive learning media PhET Simulation. The learning process consists of three main stages: preliminary activities, core activities, and closing activities. In the preliminary activities, the teacher conveyed the learning objectives, related the material to students' prior knowledge, and presented problems related to the area of a plane figure. In the core activities, the teacher introduced PhET Simulation and explained how to use the simulation. Next, students use the simulation to explore the material through observing, experimenting, and manipulating objects or representations available in the simulation. Students were guided to identify the relationship between visual representations in the simulation and mathematical concepts, discuss the results of their observations, and use the results of their exploration to solve the given problems. During the activities, the teacher acts as a facilitator by providing instructions on how to use the simulation, asking guiding questions, guiding students in their exploration, and providing explanations if students encounter difficulties. In the closing activities, students and the teacher discussed the exploration results, presented their findings, and drew conclusions about the concept of the area of a plane figure. Meanwhile, the control class received learning on the same material through conventional learning without using PhET Simulation. The treatment was carried out for 3 meetings with a duration of 70 minutes at each meeting .

### ***Research Instruments***

The research instruments consisted of a concept mathematical comprehension test and a learning motivation questionnaire. The concept comprehension test consists of 15 descriptive questions arranged based on learning indicators. The instrument test results showed that all items were valid with a Cronbach's Alpha reliability value of 0.85. The learning motivation questionnaire used a Likert scale consisting of 30 positive and negative statements based on six learning motivation indicators. The validity test results showed that all statement items were valid with a

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Cronbach's Alpha reliability value of 0.92, so that both instruments were suitable for use as data collection tools. The learning motivation questionnaire was arranged based on six learning motivation indicators, namely (1) the desire and wish to succeed in learning mathematics, (2) the drive and need to learn mathematics using PhET Simulation media, (3) the hope and aspirations for the future, (4) the appreciation in learning, (5) the existence of interesting activities in learning using PhET Simulation, and (6) the existence of a conducive learning environment.

### ***Data Collection***

Data collection was conducted after the learning process was implemented in both groups. The experimental class participated in mathematics learning using the interactive PhET Simulation media, while the control class participated in conventional learning. After all treatments were completed, both groups received a mathematical concept comprehension test and completed a learning motivation questionnaire following the same procedures.

### ***Data Analysis***

The data were analyzed using the IBM SPSS program. The analysis began with descriptive statistics to describe the characteristics of the data, then continued with prerequisite tests in the form of a normality test using Shapiro–Wilk and a homogeneity test using Levene's Test. Hypothesis testing was conducted using the Independent Samples t-test to determine differences in the ability to understand mathematical concepts and learning motivation between the experimental class and the control class. Furthermore, the effect of the interactive learning media PhET Simulation on both dependent variables was simultaneously analyzed using Multivariate Analysis of Variance (MANOVA) with a significance level of 0.05.

## **3. Results and Discussion**

The learning process in the experimental class was conducted using the interactive PhET Simulation learning media on the area of flat shapes. During the learning process, students not only received explanations from the teacher but were directly involved in exploration activities using the simulation. Students first observed the representation of the shape shown through the simulation, then manipulated the object and explored the changes that occurred to understand the relationship between shape, size, and area of the shape. Next, students use the results of their observations to test their understanding by solving the given problems. The learning activity also involved discussions to compare the results of observations and relate them to the concept of the area of flat shapes. The teacher acts as a facilitator by providing direction, guiding questions, and assistance when students encounter difficulties in using the simulation or understanding the concept. At the end of the learning, students and the teacher discussed the results of the exploration and drew conclusions about the concepts that had been learned.

To provide an overview of students' mathematical concept understanding abilities after participating in the learning, the final test results for the experimental class and control class are presented in Table 1.

Table 1. Results of Students' Mathematical Concept Understanding Ability Test

| Class      | N  | Minimum Value | Maximum Value | Average |
|------------|----|---------------|---------------|---------|
| Experiment | 30 | 70            | 95            | 81.27   |
| Control    | 30 | 55            | 90            | 70.93   |

The results of the study showed that students' mathematical conceptual understanding in the experimental class was better than in the control class. The class that received learning using the interactive learning media *PhET Simulation* obtained an average score of 81.27, while the class that followed conventional learning obtained an average score of 70.93. This average difference indicates that the use of interactive media has a positive contribution to improving students' mathematical conceptual understanding. These findings indicate that the use of *PhET Simulation* can help students understand the area of plane figures more concretely. During the learning process, students not only receive explanations from the teacher but also directly explore the available simulations. These activities provide opportunities for students to observe relationships between figures, manipulate objects, and discover concepts independently. This learning process makes it easier for students to build understanding compared to conventional learning, which tends to be teacher-centered.

Conceptual understanding is a crucial competency in mathematics learning because it relates to students' ability to explain concepts, connect them, and apply them to problem-solving (Yatri et al., 2025). The results of this study indicate that interactive learning media can reduce students' tendency to memorize formulas without understanding their meaning. The visualizations presented through *PhET Simulation* help students connect abstract concepts with visual representations, making the learning process more meaningful. The results of this study align with constructivism theory, which states that knowledge is built through active learning experiences (Tohari & Rahman, 2024). In learning using *PhET Simulation*, students have the opportunity to explore the material, test their assumptions, and receive direct feedback from the simulation. This encourages students to construct their own understanding, making the concepts learned easier to grasp and remember.

The findings of this study also support previous research showing that the use of technology-based interactive learning media can improve students' understanding of mathematical concepts. This is because interactive media can present material visually and engagingly, while providing opportunities for active learning. Therefore, the use of *PhET Simulation* can be an effective alternative learning medium for improving the quality of mathematics learning in elementary schools. The distribution of students' learning motivation levels after participating in learning using *PhET Simulation media* is presented in Table 2.

Table 2. Categories of Student Learning Motivation In Both Classes

| Category  | Frequency | Percentage |
|-----------|-----------|------------|
| Tall      | 55        | 91.67%     |
| Currently | 5         | 8.33%      |
| Low       | 0         | 0.00%      |
| Very Low  | 0         | 0.00%      |

The results of the learning motivation questionnaire from 60 students in the experimental and control classes showed that 55 students (91.67%) were in the high category and 5 students (8.33%) were in the medium category. There were no students in the low or very low category. This distribution indicates that overall student learning motivation after participating in the learning was in the high category. Differences in learning motivation between the experimental and control classes were then analyzed using the Independent Samples t-test. The increased motivation to learn was evident in the students' active participation during the lesson. Students demonstrated a heightened sense of curiosity when using simulations, actively engaged in discussions with their group mates, and gained greater confidence in completing assignments given by the teacher. Learning is no longer focused on the teacher's delivery of material but instead directly involves students in the process of discovering concepts. This resulted in increased student attention, interest, and persistence during the lesson.

*PhET Simulation* media has an attractive visual appearance and allows students to interact directly with the learning objects. These characteristics can reduce the boredom that often occurs in conventional mathematics learning. When students feel interested in the learning process, their intrinsic motivation will increase, resulting in higher engagement in each learning activity (Yanti & Wikanta, 2025). The results of this study support various previous studies that state that the use of technology-based learning media can increase student learning motivation. Interactive learning provides a more enjoyable learning experience, encouraging students to be more active, independent, and responsible for their own learning process.

### ***Hypothesis Testing***

Prior to hypothesis testing, the research data meets the assumptions of normality and homogeneity, allowing parametric analysis to be applied. Hypothesis testing was conducted using an Independent Samples t-test to determine differences in mathematical concept understanding and learning motivation between the experimental and control classes. Furthermore, to determine the effect of the PhET Simulation interactive learning media on both dependent variables simultaneously, a Multivariate Analysis of Variance (MANOVA) was used.

The results of the Independent Samples t-test are presented in Table 5. Based on the analysis results, a significance value of 0.000 ( $p < 0.05$ ) was obtained for both the ability to understand mathematical concepts and learning motivation variables. A significance value smaller than the 5% error rate indicates that  $H_0$  is rejected and  $H_1$  is accepted, so there is a significant difference between students who learn

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using the interactive learning media PhET Simulation and students who follow conventional learning. In addition, the higher average value of the experimental class compared to the control class indicates that the use of PhET Simulation provides better learning outcomes in improving students' ability to understand mathematical concepts and learning motivation. These findings indicate that interactive learning media provides a more effective learning experience than conventional learning. Through visual and interactive simulations, students have the opportunity to directly observe, explore, and manipulate learning objects. These activities help students understand mathematical concepts more deeply and increase their engagement during the learning process. In contrast, conventional learning tends to be teacher-centered, limiting students' opportunities to construct their own understanding.

To determine the effect of learning media on both dependent variables simultaneously, an analysis was conducted using MANOVA. The results of the analysis as presented in the Table show a Pillai's Trace value of 0.398, Wilks' Lambda of 0.602, Hotelling's Trace of 0.662, and Roy's Largest Root of 0.662, with an F value = 18.864 and Sig. = 0.000 in all multivariate tests. A significance value smaller than 0.05 indicates that the interactive learning media PhET Simulation has a significant influence simultaneously on students' ability to understand mathematical concepts and learning motivation.

Based on the results of *the Tests of Between-Subjects Effects test*, it is known that the interactive learning variable has a significant effect on each dependent variable. In the learning motivation variable, the F value = 15.835 was obtained with a *p value* < 0.001. These results indicate that the use of *PhET Simulation interactive learning media* has a significant effect on student learning motivation. Meanwhile, in the variable of the ability to understand mathematical concepts (questions), the F value = 18.983 was obtained with a *p value* < 0.001. This shows that *the PhET Simulation interactive learning media* also has a significant effect on students' ability to understand mathematical concepts.

Overall, the results of the hypothesis testing demonstrated that the use of PhET Simulation interactive learning media was more effective than conventional learning in improving the quality of mathematics learning in elementary schools. The improvement in mathematical concept understanding, followed by increased learning motivation, indicates that learning success is influenced not only by cognitive aspects but also by affective aspects. Therefore, integrating interactive learning media into the mathematics learning process can be an effective strategy to support the implementation of the Independent Curriculum, which emphasizes active, student-centered, and technology-based learning.

### **Discussion**

The results of the study indicate that the use of interactive learning media PhET Simulation has a significant influence on the ability to understand mathematical concepts of fourth-grade students at SDIT Marhamah Solok Selatan. This is indicated by the average ability to understand mathematical concepts of students in

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the experimental class which is higher than the control class and is strengthened by the results of the *Independent Samples t-test* and MANOVA which show a significance value of less than 0.05. These findings indicate that learning using PhET Simulation can help students understand mathematical concepts more effectively than conventional learning.

The improvement in mathematical concept understanding in this study can be explained through the relationship between the characteristics of PhET Simulation, student learning activities, and the process of forming conceptual representations. PhET Simulation provides an interactive learning environment that allows students to directly observe and manipulate objects. These characteristics encourage students to not only receive information but also actively explore the relationship between changes in the observed objects and the concept of the area of a plane figure. When students manipulate and observe visual representations, they gain experience that helps connect abstract mathematical concepts with directly observable representations. This process provides students with the opportunity to build understanding through experience, rather than simply memorizing formulas. Through simulation, students can directly observe, explore, and manipulate objects, thus gaining a more meaningful learning experience (Turnip, 2025). Learning is no longer solely oriented towards memorizing formulas, but encourages students to understand the relationships between concepts through an exploration process. This condition is in accordance with constructivism theory, which emphasizes that knowledge is actively constructed through learning experiences and interactions with the environment (Azzahra, 2025).

Exploration activities also allow students to test their understanding through given problems. As students observe simulation results, discuss their findings, and relate them to area calculations, a connection between visual representations and mathematical procedures occurs. Thus, the use of PhET not only makes learning more engaging but also provides a learning experience that helps students grasp the meaning behind the concepts and formulas used.

In addition to improving students' understanding of mathematical concepts, the use of PhET Simulation has also been shown to increase student motivation. The majority of students ranked highly motivated after participating in learning using this medium. These findings demonstrate that interactive learning media can create a more engaging, enjoyable, and challenging learning environment. Visual displays, animations, and opportunities to interact directly with learning materials enhance student enthusiasm for learning activities. This leads to increased student attention, interest, activeness, and self-confidence throughout the learning process.

The results of this study are in line with the theory of learning motivation which states that an interesting learning environment and providing positive learning experiences can increase students' intrinsic motivation (Renata et al., 2024). When students feel interested in the learning process, they will be more active in seeking information, participating in discussions, and trying to complete the assigned tasks (Soro et al., 2024). Thus, increasing learning motivation is one factor that contributes to improving students' ability to understand mathematical concepts.

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The results of this study are also supported by various previous studies showing that the use of technology-based learning media can improve learning outcomes and student conceptual understanding. Interactive media allows students to gain more concrete learning experiences through visualizations and simulations, making previously difficult concepts easier to grasp (Kristiawan et al., 2026). Furthermore, the use of digital media provides students with opportunities for independent, active, and collaborative learning, ultimately positively impacting learning outcomes.

MANOVA analysis showed that PhET Simulation not only affected each variable separately but also simultaneously influenced students' mathematical concept understanding and learning motivation. This finding suggests that successful mathematics learning is not solely determined by cognitive aspects but also influenced by affective aspects. High learning motivation encourages students to be more active in learning, while a good conceptual understanding increases students' confidence in solving various mathematical problems (Aprilita & Handican, 2023). These two aspects support each other in producing a more effective learning process.

Practically, the results of this study imply that PhET Simulation can be used as an alternative learning medium for mathematics in elementary schools, particularly for materials requiring conceptual visualization. The use of this medium aligns with the implementation of the Independent Curriculum, which emphasizes student-centered learning, the use of digital technology, and the development of critical thinking and problem-solving skills. Therefore, teachers are advised to integrate PhET Simulation with active and collaborative learning models to make the learning process more innovative, meaningful, and optimally improve student learning outcomes.

#### **4. Conclusion**

This study concludes that the use of PhET Simulation as an interactive learning medium has a positive effect on fourth-grade students' mathematical concept understanding and learning motivation in learning the area of plane figures. Students who participated in learning with PhET Simulation demonstrated better mathematical concept understanding than those who experienced conventional learning. The interactive visualizations and exploration activities enable students to connect mathematical representations with concepts, explore relationships between shapes and their areas, and develop a more meaningful understanding of the material. Furthermore, the use of PhET Simulation supported a more engaging learning environment that encouraged students to participate actively and maintain their interest in learning mathematics. The findings indicate that integrating interactive digital media into elementary mathematics instruction can support both cognitive and affective aspects of learning. Therefore, PhET Simulation can serve as an alternative learning medium for teachers seeking to provide more interactive, student-centered, and meaningful mathematics instruction. However, this study was limited to a relatively small sample from one school and employed a posttest-only

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design. Future research should involve students from multiple schools and use a pretest-posttest design to examine changes in mathematical concept understanding and learning motivation more comprehensively. Further studies may also explore the application of PhET Simulation to other mathematical topics and grade levels.

## References

- Anggraini, D. M., Sastranegara, A. M., & Nabila, H. (2026). Rendahnya Pemahaman Konsep Matematika pada Siswa SD/MI. *Jurnal Perspektif Ilmu Pendidikan dan Keguruan*, 1(2), 98–102. <https://doi.org/10.66618/jpipk.v1i2.990>
- Aprilita, T. D., & Handican, R. (2023). Persepsi Siswa Terhadap Implementasi Model Problem Based Learning pada Mata Pelajaran Matematika. *Griya Journal of Mathematics Education and Application*, 3(3), 546–560. <https://doi.org/10.29303/griya.v3i3.353>
- Azzahra, N. T. (2025). Teori Konstruktivisme Dalam Dunia Pembelajaran. *Jurnal Ilmiah Research Student*, 2(2), 64–75. <https://doi.org/10.61722/jirs.v2i2.4762>
- Erika Setiowati, Syamsul Hadi, Maria Ulfa, Ahmad Dainuri, Fajar Sholeh, Miftahus Surur, & Zainul Munawwir. (2024). Analisis Kemampuan Literasi Matematika Dalam Meningkatkan Kemampuan Berpikir Kritis Siswa. *Jurnal Kajian Penelitian Pendidikan dan Kebudayaan*, 2(2), 55–68. <https://doi.org/10.59031/jkppk.v2i2.321>
- Gusmarlia, F. (2025). Pentingnya Konsep Dasar Matematika Di Sekolah Dasar. *Jurnal Literasiologi*, 9(4), 1–7. <https://doi.org/10.47783/literasiologi.v9i4>
- Irma Maulidia & Ibnu Muthi. (2025). Efektivitas Penggunaan Media Pembelajaran Interaktif Berbasis Multimedia dalam Meningkatkan Minat Belajar Matematika pada Siswa SD. *Mutiara : Jurnal Penelitian dan Karya Ilmiah*, 3(4), 10–24. <https://doi.org/10.59059/mutiara.v3i4.2624>
- Jannah, R., Soraya, R. A., Suriansyah, A., & Cinantya, C. (2024). Kemampuan Berpikir Kritis dalam Pembelajaran Matematika Terhadap Hasil Belajar Di Sekolah Dasar. *MARAS: Jurnal Penelitian Multidisiplin*, 2(4), 1991–1998. <https://doi.org/10.60126/maras.v2i4.550>
- Kristiawan, T., Afandi, M., & Agung, U. I. S. (2026). Media Phet Simulation Sebagai Alat Efektif Meningkatkan Pemahaman Konsep Matematika Siswa Sekolah Dasar: Suatu Literature Review. *Pendas : Jurnal Ilmiah Pendidikan Dasar*, 11(02), 172–186. <https://doi.org/10.23969/jp.v11i02.52313>
- Listiyoningrum, W., Roshayanti, F., Widayati, L., & Zuhri, M. S. (2024). Penggunaan Media Interaktif Phet Colorado dalam Pembelajaran Pecahan Kelas IV SDN Tambakrejo 01 Semarang. *Kognitif: Jurnal Riset HOTS Pendidikan Matematika*, 4(1). <https://doi.org/10.51574/kognitif.v4i1.1337>
- Putrawangsa, S., & Hasanah, U. (2022). Analisis Capaian Siswa Indonesia Pada PISA dan Urgensi Kurikulum Berorientasi Literasi dan Numerasi. 1(1), 1–12. <https://doi.org/10.60004/edupedika.v1i1.1>
- Renata, Z., Oktavia, I., Irawan, D., Rohmaturobbi, A. N., Pebrianto, A., Nurhidayati, L., & Anggia, I. P. (2024). Efektivitas Penggunaan Media Games Edukasi Berbasis Teknologi: Wordwall Terhadap Motivasi Belajar

- 
- Siswa. *Griya Journal of Mathematics Education and Application*, 4(4), 322–330. <https://doi.org/10.29303/griya.v4i4.497>
- Saputra, H. (2024). Penguatan Kemampuan Peserta Didik Dalam Menghadapi Era Society 5.0 Melalui Pembelajaran Matematika. *Jurnal Pendidikan Bhinneka Tunggal Ika*, 2(2), 287–302. <https://doi.org/10.51903/bersatu.v2i2.640>
- Soro, S. H., Suherman, M., & Masrukoyah, E. (2024). Penerapan Metode Pembelajaran Berbasis Kolaboratif dalam Meningkatkan Keaktifan Belajar Siswa (Studi Kasus Siswa SMP Negeri 1 Warungkondang). *EDUKASIA: Jurnal Pendidikan dan Pembelajaran*, 5(1), 2423–2430. <https://doi.org/10.62775/edukasia.v5i1.1310>
- Tohari, B., & Rahman, A. (2024). Konstruktivisme Lev Semonovich Vygotsky dan Jerome Bruner: Model Pembelajaran Aktif dalam Pengembangan Kemampuan Kognitif Anak. *Nusantara: Jurnal Pendidikan Indonesia*, 4(1), 209–228. <https://doi.org/10.14421/njpi.2024.v4i1-13>
- Turnip, S. H. (2025). Pengaruh Metode Simulasi terhadap Pemahaman Konsep Siswa Kelas X pada Pembelajaran Kinematika Gerak. *Seminar Nasional Teknologi Dan Multidisiplin Ilmu (Semnastekmu)*, 5(1), 374–384. <https://doi.org/10.51903/xrvfn538>
- Ulfa, N., & Wahyuni, S. (2025). Analisis Pengaruh Penggunaan Laboratorium Virtual (PhET Simulations) Terhadap Hasil Belajar IPA Siswa SMP: Study Literature Review. *Kalam Cendekia: Jurnal Ilmiah Kependidikan*, 13(2), 1469–1478. <https://doi.org/10.20961/jkc.v13i2.103602>
- Widiani, S., & Soepudin, U. (2025). Praktik Baik Pembelajaran Matematika Sekolah Dasar Berbasis Kontekstual dan Reflektif Untuk Penguatan Literasi Numerasi Dan Karakter Siswa. *Journal of Rural and Development*, 13(2), 70–79. <https://doi.org/10.20961/jr&d.v13i2.115123>
- Yanti, F. D., & Wikanta, W. (2025). Peran Peserta Didik Dalam Proses Pembelajaran: Analisis Pengaruh Terhadap Motivasi Belajar. *Journal of Science, Education and Studies*, 4(02), 79–88. <https://doi.org/10.30651/jses.v4i2.25121>
- Yatri, A. E., Suradi, S., & Danial, D. (2025). Kajian Literatur: Faktor Penyebab Kesulitan dalam Pemahaman Konsep Matematis pada Siswa. *Lattice Journal : Journal of Mathematics Education and Applied*, 5(2), 146–159. <http://dx.doi.org/10.30983/lattice.v5i2.10469>
- Zaujaha, U. M., Sunaengsih, C., & Panjaitan, R. L. (2026). Pelaksanaan Pembelajaran Berbantuan Virtual PhET pada Materi Rangkaian Listrik Kelas V Sekolah Dasar. *JURNAL PENDIDIKAN MIPA*, 16(4), 1645–1657. <https://doi.org/10.37630/jpm.v16i4.4966>

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