

**THE USE OF TEACHING PROPS TO IMPROVE MATHEMATICS
LEARNING OUTCOMES IN NUMBER PATTERN MATERIAL IN STEM
VILLAGE YOGYAKARTA**

KARYA TULIS ILMIAH



DIAJUKAN UNTUK MELENGKAPI PERSYARATAN
PENYELESAIAN PROGRAM KARYA TULIS ILMIAH
(KTI)

DISUSUN OLEH :

FIKA ARIANA

20310048

**FAKULTAS PENDIDIKAN MATEMATIKA ILMU
PENGETAHUAN ALAM DAN TEKNOLOGI
INFORMASI (FPMIPATI)
UNIVERSITAS PGRI SEMARANG**

2024

LEMBAR PENGESAHAN

Naskah KTI berjudul “The use of teaching props to improve mathematics learning outcomes in number pattern material in STEM village Yogyakarta” yang disusun oleh

Nama : Fika Ariana

NIM : 20310048

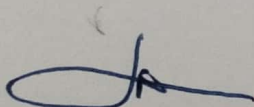
Program Studi : Pendidikan Matematika

telah didiseminasikan pada hari Kamis, tanggal 4, bulan April tahun 2024 dan dinyatakan memenuhi syarat untuk memperoleh gelar Sarjana.

Semarang, 4 April 2024

Panitia Diseminasi

Ketua

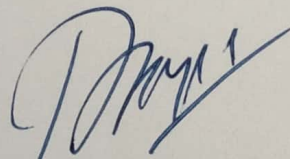


Dr. Supandi, S.Si., M.Si.

NPP 09741245



Sekretaris



Dr. Muhammad Prayito, S.Pd., M.Pd.

NPP 11860133

1. Dr. Muhammad Prayito, S.Pd., M.Pd.

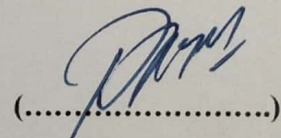
NPP 11860133

2. Nurina Happy, M.Pd.

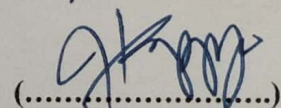
NPP 148901448

3. Dr. Lukman Harun, M.Pd.

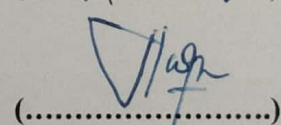
NPP 118601357



(.....)



(.....)



(.....)

SURAT PERNYATAAN

Yth. Ketua Program Studi Pendidikan Matematika

Dengan hormat,

yang bertanda tangan di bawah ini,

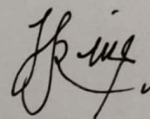
Nama : Fika Ariana

NPM : 20310048

menyatakan memilih karya tulis ilmiah sebagai bentuk tugas akhir dalam rangka menyelesaikan studi sarjana di Universitas PGRI Semarang. Saya bersedia mengikuti prosedur penulisan karya tulis ilmiah hingga selesai dengan penuh tanggung jawab.

Semarang, 4 April 2024

Yang menyatakan,



Fika Ariana

NPM. 20310048

MOTTO DAN PERSEMBAHAN

MOTTO

Sukses Bukanlah Milik Orang Yang Tidak Pernah Gagal, Tetapi Orang Yang Tidak Pernah Menyerah Setelah Gagal.”

– Abraham Lincoln

PERSEMBAHAN

Karya Tulis Ilmiah (KTI) ini penulis dedikasikan kepada kedua orang tua tercinta, Ayahanda dan ibunda yang selalu mendukung dan mendoakan putrinya dengan setulus hati. Serta untuk orang-orang terdekat yang selalu memberikan semangat dan untuk almamater kebanggaan

DAFTAR ISI

LEMBAR PENGESAHAN	ii
SURAT PERNYATAAN	iii
MOTTO DAN PERSEMBAHAN.....	iv
KATA PENGANTAR	v
NASKAH ARTIKEL.....	7
LAMPIRAN-LAMPIRAN	26

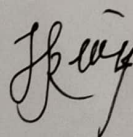
KATA PENGANTAR

Kami ucapkan puji syukur serta nikmat kepada Tuhan Yang Maha Esa atas rahmat-Nya yang melimpah sehingga saya dapat menyelesaikan Karya Tulis Ilmiah (KTI). Laporan ini dibuat untuk memenuhi Persyaratan Desiminasi Karya Tulis Ilmiah (KTI). Keberhasilan penulis laporan desiminasi ini tidak terlepas dari bantuan dan bimbingan dari berbagai pihak terkait yang terkait. Untuk itu dalam kesempatan ini disampaikan terimakasih kepada :

1. Ibu Dr. Sri Suciati, M. Hum., selaku Rektor Universitas PGRI Semarang yang telah mengizinkan kami menuntut ilmu di Universitas ini.
2. Bapak Dr. Supandi, S.Pd.,M.Pd, selaku Dekan FPMIPATI
3. Bapak Dr.Muhammad Prayito, S.Pd.,M.Pd, selaku Ketua Prodi Pendidikan Matematika dan Dosen Pembimbing I
4. Ibu Nurina Happy, M.Pd, selaku Dosen Pembimbing II
5. Bapak/ Ibu Dosen Pendidikan Matematika Universitas PGRI Semarang
6. Dr. Sumardyono selaku dewan direksi Seameo Qitep In Mathematics yang telah memberikan izin untuk penelitian ini
7. Seluruh staff Seameo Qitep In Mathematics yang telah memberikan bantuan pada kegiatan penelitian ini
8. Seluruh rekan seperjuangan yang mengikuti magang kerja/ industri di SEAMEO Regional Centre for Qitep in Mathematics

Akhir kata penyusun mengucapkan terima kasih, semoga laporan magang ini dapat berguna dan bermanfaat bagi pembaca.

Semarang, 4 April 2024



Fika Ariana

NASKAH ARTIKEL

The use of teaching props to improve mathematics learning outcomes in number pattern material in STEM village Yogyakarta

Fika Ariana ^{1*}, Muhammad Prayito ¹, Nurina Happy ¹, Wisnuningtyas Wirani ²

¹ University PGRI Semarang, Semarang, Jawa Tengah, 50232, Indonesia

² SEAMO Regional Center for QITEP in Mathematics, D. I. Yogyakarta, 55281, Indonesia

* Corresponding Author. Email: fikaariana12@gmail.com

Received: 2 February 2024; Revised: 16 February 2024; Accepted: 1 March 2024

Abstract: Since mathematics is an abstract discipline, context is necessary to understand it when learning. This pilot study at SDN 1 Kentungan, a "STEM Village" in Joho Village, Yogyakarta, aims to determine the impact of stick-board teaching aids on second-grade students' mathematics learning results in the domain of number patterns. The devices used for collecting data include pre- and posttests, interview sheets, observation sheets, and other methods. Meanwhile, the small set of test participants consisted of two class II students from SD N 1 Kentungan who attended the STEM Village in Kampung, Joho. The conclusions of this descriptive study show the following: (1) the way teaching tools are used affects how number patterns are taught to primary school pupils; when instructional aids are utilized to assist students in learning a subject more easily and contextually, they are guided by more than just formulas. (2) Students perform better on their pretest and posttest. (3) Students' understanding improves after using visual aids compared to before using them. (4) Students become more curious and engaged in the learning process. The results of the study suggest that class II students at SDN 1 Kentungan benefit from the use of instructional aids, which are regarded as effective and well-done.

Keywords: Effective, Stick board, Mathematics learning, Number pattern

INTRODUCTION

Learning is defined as a combination consisting of human elements, materials, facilities, equipment, and procedures. Dron (2022) emphasizes the collective nature of learning, highlighting the importance of learners, teachers, and the learning environment. In this context, learning is viewed as a complex process involving many components working together (González-Pérez & Ramírez-Montoya, 2022). Mathematics learning is an educational activity that utilizes mathematics as a tool to achieve predetermined goals. This emphasizes the importance of mathematics in the context of learning, where mathematics is used as a meansto achieve

predefined learning objectives ([Goos et al., 2020](#)). From elementary school through college, mathematics is a subject that is applied and taught at all educational levels ([Khotimahet al., 2021](#)). Since mathematics is essential to everyday life, one needs knowledge facilities in order to utilize this knowledge. The goal of using mathematics in education is to provide students the tools they need to think critically, logically, and cooperatively ([Dolapcioglu & Doğanay, 2022](#); [Jablonka, 2020](#)).

Based on the statement, it can be affirmed that the use of mathematics in education aims to equip students with critical, logical, and cooperative thinking skills, which are essential skills for success in their future lives and careers. Furthermore, the application of mathematical knowledge is also utilized in daily activities. For instance, the arrangement of billiard balls, seating arrangements in cinemas, seating arrangements in stadiums, etc. The utilization of mathematical knowledge, aided by aids in number patterns, enables us to predict what will happen next, thereby providing a sense of orderliness to each number pattern. But this is a paradox. Due to their perception that mathematics is a challenging topic, the majority of students have serious misgivings about the subject and are therefore not very interested in it. Teachers also need to come up with innovative teaching strategies, particularly the use of learning media, in order to spark students' curiosity about mathematics and facilitate their application of it. This is one attempt to boost pupils' enthusiasm for learning mathematics. The use of teaching aids in mathematics learning must be tailored to the topic of study and the developmental level of the students. Teaching aids are teaching aids in the form of concrete objects, imitations of objects, pictures, films, tapes, and others, which function to clarify presentations. According to [Russeffendi \(1996\)](#), teaching aids are instruments used to explain or illustrate mathematical concepts, which can be real objects or pictures. Despite having advantages and disadvantages, such as the ability to be moved or manipulated but cannot be presented in the form of writing or books, the use of teaching aids has significant functions and benefits in mathematics learning. Among them, students will participate more actively in mathematics learning with enthusiasm, gain better understanding and knowledge, and become aware of the relationship between mathematical concepts and their surrounding environment. The type of tool used by the researcher is mathematical manipulatives, which are physical objects used to visualize mathematical concepts. An example is the stick board used by the researcher. This tool can be moved or manipulated by students to understand concepts such as addition, subtraction, multiplication, division, or geometry.

As an additional note, the researcher utilizes instructional media. Utilizing media only serves to increase students' role-playing activity. Excellent in picking up new information and comprehending it within a certain context. Naturally. This was made into a useful and important tool by the teacher, who used an easy-to-understand approach to educate the class on understanding learning, particularly studying mathematics. In agreement with [Ariyanto, et al.\(2018\)](#), learning

media ought to function as communication tools for disseminating information. Based on the statement, it asserts that instructional media should function as a communication tool to disseminate information and facilitate learning success. This statement aligns with the concept that instructional media can be used to create enjoyable and effective learning experiences for students. In this regard, educators need to consider innovative aspects in the development of instructional media, including environmental studies, foundational principles, and rational theories. This emphasizes that instructional media development is not just about selecting available technology or media, but also considering the contexts and theories that support learning success. Thus, enjoyable learning can enhance students' motivation and active engagement in the learning process.

In facing the challenges of learning, many educators still tend to rely on the use of formulas in the teaching process. Therefore, it is important to introduce instructional media that can help students think contextually. One form of applying instructional media is the use of teaching aids, often referred to as visual aids. In evaluating the effectiveness of the learning process, the role of visual aids is crucial. Teaching aids are visual and auditory tools that teachers can utilize to facilitate learning, thereby enhancing the effectiveness and efficiency of students in acquiring information ([Gallagher et al., 2022](#)). This explanation emphasizes the importance of using teaching aids as a means to deliver material visually and auditorily, thus making it easier for students to understand the information being taught. This statement also asserts that elementary school students can experience psychological benefits from engaging in an interesting learning environment. Furthermore, according to a study conducted by [Fitria \(2014\)](#), instructional media can help enhance the effectiveness of the learning process in conveying the message and content of lessons. She also asserts that the use of instructional media can increase students' motivation to learn, thus enabling them to absorb the material more easily. Research conducted by [Supriyono \(2018\)](#) also indicates that the use of teaching aids can stimulate students to learn more actively, innovatively, creatively, and enjoyably. Thus, this research provides further evidence that the use of teaching aids can create an engaging learning environment and help increase students' active participation in the learning process ([Murdiyanto & Mahatama, 2014](#)).

This aligns with the concrete operational stage in Piaget's theory of cognitive development ([Piaget, 1952](#)). In his theory, cognitive development occurs in four stages: sensorimotor, preoperational, concrete operational, and formal operational. The sensorimotor stage, which lasts from birth to age 2, is when infants begin to build an understanding of the world through sensory experiences and movement, as well as grasp the concept of object permanence. In the preoperational stage, occurring from ages 2 to 7, children understand reality using symbolic functions or signs but are still limited by egocentrism, animism, and centration. The concrete operational stage, spanning from ages 7 to 11/12, is a phase where children can use logical

thinking for existing physical objects without leaning towards animism and artificialism. Lastly, the formal operational stage, starting from age 12 and above, is when children can use concrete operations to form more complex thoughts, such as hypotheses, abstractions, deductions, inductions, as well as logic and probability.

Therefore, the availability of visual aids for learning is one method to clarify abstract understanding. For example, in elementary school mathematics education, teachers can use aids such as math blocks, colored cubes, or number cards to help students understand concepts like addition, subtraction, multiplication, and division. For instance, by using math blocks, students can directly manipulate real objects to visualize abstract mathematical operations. This allows students to experience mathematical concepts concretely and reinforce their understanding through hands-on experience, making learning more engaging and interactive. This can also be applied in the context of the mathematics learning process to facilitate mathematics learning for elementary school students, enhance their understanding, and make learning more interesting and enjoyable.

The use of teaching aids is believed to enhance students' understanding of the subject matter, potentially improving their learning outcomes. Research by [Suwardi et al. \(2014\)](#) demonstrates the significant impact of teaching aids on students' learning outcomes, affecting their academic achievements. With teaching aids, students can learn while playing, making the learning process engaging and enjoyable. This is consistent with the views of [Arsana, et al. \(2019\)](#), stating that learning through physical activities enhances understanding of the material and makes learning more enjoyable. When teaching aids are used, students actively engage in problem-solving, fostering creativity and critical thinking. This is evident from students' enthusiasm in trying out teaching aids such as stick boards. According to [Unaenah \(2023\)](#), the primary goal of using instructional aids is to develop original ideas or expand abstract notions so that students may comprehend their actual meaning and apply them effectively rather than just memorizing preexisting formulas. By utilizing instructional aids, students are expected to grasp the true meaning of the concepts being taught and apply them effectively in various contexts. This approach emphasizes deep understanding and students' ability to relate concepts to real-world situations, rather than merely memorizing information without understanding its context. By doing this, this study contributes to a better understanding of the role of aids in mathematics education and provides a stronger foundation for the development of more effective teaching practices in the classroom. For example, in everyday life, the use of aids in mathematics education may be underutilized in schools due to resource constraints or a lack of understanding of their benefits. This can lead to students struggling to grasp abstract mathematical concepts. By addressing this gap, this study will explore how aids such as math blocks, colored cubes, or number cards can be used in mathematics instruction in the development of more effective teaching

practices in the classroom. For example, in everyday life, the use of aids in mathematics education may be underutilized in schools due to resource constraints or a lack of understanding of their benefits. This can lead to students struggling to grasp abstract mathematical concepts. By addressing this gap, this study will explore how aids such as math blocks, colored cubes, or number cards can be used in mathematics instruction in the classroom to help students visualize mathematical concepts concretely and enhance their interest and learning achievements. In the use of teaching aids, the researcher encountered several obstacles during the learning process, including the presence of students who were still not fully focused on the teacher's presentation using teaching aids, resulting in a less conducive learning environment. To address this issue, the researcher conducted ice breaking activities and provided additional explanations to ensure that the students remained calm.

The researcher chose to implement instructional aids in teaching the concept of number patterns due to its significance in everyday life. According to a study by Fikri, et al. (2022), understanding number patterns is crucial as it serves as the foundation for other concepts such as arithmetic and geometric sequences, and aids in comprehending the relevance of mathematics in real-life situations. This content serves as a crucial groundwork for further mathematical education; without it, students may struggle with addition, multiplication, division, and subtraction. Moreover, the practical application in daily life can be utilized for organizing daily or weekly schedules, in business operations, where number patterns can be used to predict demand and manage inventory more efficiently. By observing recurring sales patterns, a retailer can order additional stock before running out, thus avoiding shortages during peak demand, etc. Students are expected to develop organized and methodical thinking patterns as a result of learning about number patterns.

Based on the results of the mathematics pretest scores, students' performance is still relatively low. Despite having knowledge of the formulas to be used, students often struggle to apply these formulas in problem-solving, relying more on abstract concepts rather than concrete ones. This aligns with findings from research conducted by Amaliyah, et al (2020), they concluded that one of the difficulties students' faces is recalling the formulas they have learned, contributing to their decreased grades. From these findings, the researcher identified two main issues to be addressed in this study. First, the extent to which instructional aids are effective in helping students understand and master number pattern concepts. Second, how students respond to the use of instructional aids in learning number pattern topics, whether they feel assisted or engaged with the use of these aids.

Owing to the issues raised, the researcher comes to the conclusion that research on the comparative use of mathematics teaching aids for primary school children is necessary in order to realize the goal of enhancing students' abilities and developing their full potential. This is to

evaluate the effectiveness of using aids in increasing the interest and learning outcomes of elementary school students in mathematics. This research aims to utilize aids to improve mathematics learning outcomes on number patterns at STEM Village, Yogyakarta.

METHOD

The research methodology employs a qualitative and descriptive approach. The researcher will utilize qualitative analysis techniques, particularly thematic analysis, to identify key patterns in students' responses to open-ended questions. The reason for using qualitative research is to gain a deep understanding of students' experiences and perceptions regarding the use of manipulatives in mathematics learning. The qualitative approach was chosen because it allows researchers to explore in more detail how students respond to and interact with the use of manipulatives in the context of learning number patterns. Thus, the qualitative approach is seen as an appropriate way to achieve the research goals of obtaining in-depth and comprehensive insights into the use of manipulatives to enhance mathematics learning outcomes on number patterns at STEM Village Yogyakarta. This study is expected to provide a general overview of phenomena related to the topic (Annur & Hermansyah, 2020).

The research was conducted at STEM Village Yogyakarta, specifically in Desa Joho. Two second-grade students from SD N 1 Kentungan who participated in STEM Village in Kampung Joho were selected as a small group of subjects for the researcher. Participants were chosen through purposive sampling because they were second-grade students actively participating in the STEM Village program in Kampung Joho. This selection was based on inclusion criteria, including active involvement in the program and willingness to participate in the research. Additionally, the selection of a specific school (SD N 1 Kentungan) may have been based on accessibility and cooperation with the organizers to conduct the research. Thus, the selection of participants and the research location was based on practical considerations and relevance to the research topic. The research was conducted every Friday for three meetings in May 2023, specifically on May 12, May 19, and May 26, 2023, with each meeting lasting ninety minutes, starting at 3:30 PM to 5:00 PM WIB.

Pretests, posttests, interview sheets, and observation sheets are the methods used to collect data. Pretest and posttest sheets contain questions related to students' knowledge or understanding of the number pattern material that has been learned. These sheets are administered before and after the use of manipulatives in teaching. For the interview sheet, questions may cover the experiences, views, or opinions of respondents regarding the learning process using manipulatives. Meanwhile, for the observation sheet, the criteria used are student responses and the level of specific activity observed during the learning process. Meanwhile,

interactive methods are used for data analysis. According to Milles & Huberman (1992:16), analysis consists of three concurrent activities: data reduction, data display, and conclusion drawing/verification. Interactive data analysis: collecting data, presenting data, and validating or drawing conclusions.

This study utilizes various tools, such as interviews and several multiple-choice and essay questions. These questions are used simultaneously in the pretest and posttest procedures to measure students' understanding of the presented material and teaching exploration. This test consists of five essay questions and ten multiple-choice questions, with a test duration of thirty minutes. In designing the test questions, the researcher aims to ensure that each question is designed to assess students' understanding of the concepts. For multiple-choice questions, the researcher presents situations or concrete examples that require students to identify number patterns or apply number pattern concepts. As for the essay questions, the researcher asks students to explain number pattern concepts or apply number patterns in real-life situations. Additionally, there are five open-ended questions listed in the interview form. These questions are designed to determine students' difficulties and ease in understanding number patterns using teaching aids, along with ten aspects of questions used for observation. By utilizing pre-test and post-test observation sheets, interviews, and observations, this integrates the learning test results. Below is the sequence of activities.

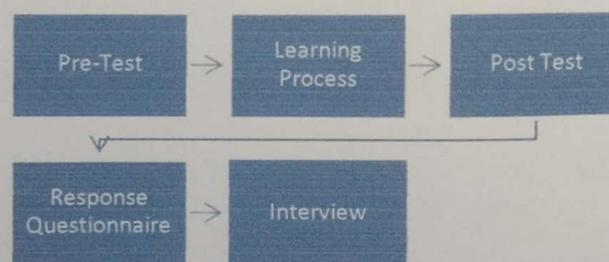


Figure 1. Sequence of Activities

In Figure 1, the researcher conducts a pretest first. This is done to assess the initial understanding of students regarding the material to be taught. Then the learning process is carried out using the prepared manipulatives. After the learning process is completed, a posttest is conducted to assess the students' understanding after the learning process. After the learning process, the researcher fills out a response questionnaire. Next, an interview process is conducted by filling out the form provided by the researcher and providing feedback on the answers given by the students.

Use Minimum Completeness Criteria (KKM) to examine markers of students' progress in the learning process. Khaeruddin (2007) defines the Minimum Completeness Criteria as the attainment

of the principles of ability in learning, which refers to the students' accomplishment of abilities in fundamental subjects in each subject. KKM can also be defined as the minimum standard score that students must achieve to be declared passed or completed in a subject or learning process. KKM is usually set by the government or educational institutions as guidelines for teachers in evaluating students' learning outcomes. If students' scores reach or exceed the KKM, then students are considered to have achieved the standard set for the subject matter. The optimal or maximum value, according to the KKM guidelines, is 100. Nonetheless, it is anticipated that the calculated national value will at least equal 75, or 75, which is also known as the national KKM value.

RESULTS AND DISCUSSION

Results

The purpose of this study was to describe the findings of data analysis regarding the impact of the stick board aids. The data analysis included four different analyses: (1) Activities conducted by students, data on student activities can be collected through direct observation in the classroom or by using recording tools such as activity journals or participation records; (2) Student responses during the learning process are obtained through interviews and observations or observation sheets; (3) Educator's ability in managing learning can be observed from the success rate before and after the learning process; (4) Learning outcomes tests conducted by students use pre-test and post-test scores and analysis to evaluate the effectiveness of learning. This analysis's output allows for the identification of variations in math learning outcomes before and after the use of math teaching tools to number pattern content. Finding out if employing visual aids can be more effective than not using them is another outcome. The collected research data is therefore subject to additional descriptive and interactive analysis.

Results of Descriptive Statistical Analysis

According to the scores on the student activity observation sheet, which was used to record all student activities during number patterns utilizing stick board aids mathematics learning activities, as indicated in the [Table 1](#).

Table 1. Pretest Results Statistics Table

<u>No.</u>	<u>Name</u>	<u>Pre-test</u>
1.	A1	32
2.	B1	48

Based on the results of the pre-test in [Table 1](#), students were unable to surpass the Minimum Completeness Criteria (KKM), where the KKM for mathematics learning that must be achieved is 75. To achieve learning goals, effective interaction between teachers and students, as well as feedback responses occurring within the educational environment, are necessary ([Carless, 2022](#)). The effectiveness of the learning process is greatly influenced by various aspects, one of which is the use of instructional media that plays a crucial role in supporting knowledge acquisition during the learning process.

A stick board is used as an instructional tool in the learning media in this study. In his fourth book series, *Teaching Modern Mathematics*, [Ruseffendi \(1981\)](#) lists a number of standards for effective teaching tools, including: 1) Aids need to be long-lasting (made of tough, robust materials) in order to be utilized for extended periods of time; 2) Is appealing in both color and shape; 3) To facilitate application, have a basic idea or concept; 4) The size is appropriate for the pupils' physical stature and neither too large nor too little; 5) Able to illustrate mathematical ideas with real-world images or diagrams; 6) Assign instructional aids that correspond with the subject being studied; 7) Has the ability to make mathematical ideas easier to understand rather than more difficult; 8) Serve as a foundation for pupils' development of abstract thought concepts; 9) It is movable, playable, and disassemble able; 10) If at all possible, the instructional tools are multipurpose or may be employed with other materials.

A stick is used as a prop by researchers. The stick board aids were constructed using styrofoam, ice cream sticks, colored folded paper, colorful straws, and other materials determined by the criteria analysis results. Therefore, because stick board is simple to produce, colorful, and easy to make, it can be stated to be a material that is appealing, durable, and simple in idea. Stick boards are genuine things that are easy to handle and disassemble. They are neither too large nor little in size. Students can learn number pattern material in relation to the researcher's difficulties by using this keyboard. The researcher has provided students with an example of how



to use the aids before they apply them, as seen in [Figure 2](#). The researcher has provided students with an example of how to use the aids before they apply them, as seen in [Figure 2](#).

Figure 2. Learning Process

In [Figure 2](#), students are engaged in the learning process using the provided manipulatives. It is evident from [Figure 2](#) that the students are actively experimenting with the available stickboard.

Data was collected as indicated in Table 2, which is based on the findings of study done on how the pretest and posttest questionnaires were completed.

Table 2. Student Grade Data

No.	Name	Score		Percentage Increase (from 100)
		Pre- Test	Post- Test	
1.	A1	32	80	48%
2.	B1	60	80	20%

The information in Table 2 indicates that using instructional aids is highly advantageous for pupils since it raises their grades. It is possible to conclude that the teaching tools included in the number pattern material are useful and effective for use in helping students learn mathematics because the combined results of the two tests showed an increase of more than 10%. In addition, it has been demonstrated that the usage of instructional aids satisfies the success indicators. The accuracy of the answers to the posttest questions serves as evidence for this claim. The findings demonstrate that every student who completed the whole learning process and engaged in the posttest activities was able to get scores above 75 or the KKM.

Discussion

Based on the research implementation, during the pre-test, results were obtained which did not meet the KKM criteria. Additionally, during the learning process, students still appeared passive, as evidenced by their difficulty in solving the given problems. After identifying the condition of the students during the pre-test, the subsequent learning process was conducted using manipulatives to improve mathematics learning outcomes in the number pattern material. In the second meeting, students showed active responses related to the learning process. In this meeting, students began to dare to provide feedback on questions from the researcher, although not yet maximally. In the third meeting, students showed significant changes, evidenced by post-test scores exceeding the KKM. The following outcomes were attained using data analysis approaches and success indicators. To measure the level of learning success based on the number of students who successfully achieve the learning objectives.

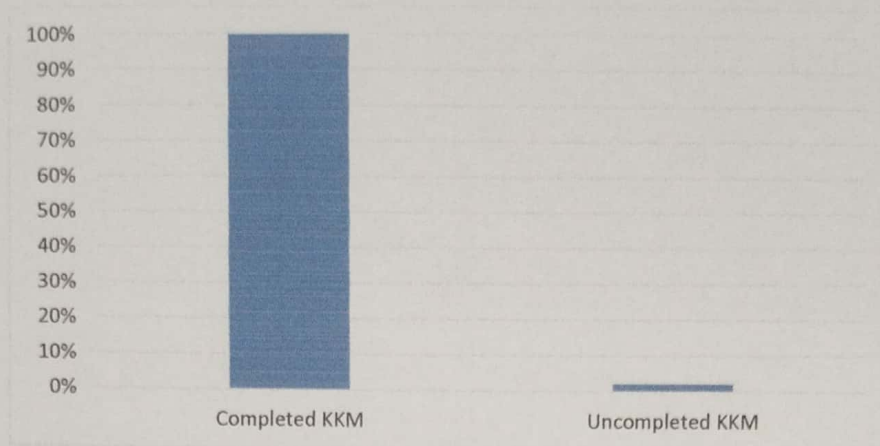


Figure 3. Level of effectiveness of the user of the teaching assist

Figure 3 level of effectiveness of using teaching aids (in percent), with student completed KKM 100% and uncompleted KKM 0%. The graph above illustrates the percentage of students who have exceeded the Minimum Mastery Criteria (KKM) in the learning process after using teaching aids. It shows how many students have achieved or exceeded the minimum standard set for success in the subject. From the obtained results, it can be analyzed that the teaching aids are effective in delivering number pattern content to STEM Village students during the learning process, as expressed by the following participants: Provide quotes or excerpts from student feedback or testimonials, if available, to support the effectiveness of the teaching aids.

"After using teaching aids, students find it easier to understand the taught material and the learning process becomes more enjoyable because students can learn while playing."
(Interview with A1, Grade II, on May 26, 2023)

Therefore, the use of teaching aids in learning not only enhances students' understanding of the material but also creates a more positive and engaging learning experience for them. This can have a positive impact on students' learning motivation and academic achievement overall. Aside from that, the learning process follows the learning objectives and yields the anticipated results, which makes this learning approach considered effective. Furthermore, based on examination of filling out response sheets carried out by pupils. The school has started using learning media, also known as visual aids. Aids are employed, though, to convey extra information.

The use of teaching aids in learning has a significant positive impact on student participation and understanding of the taught concepts. With visually appealing and interactive materials, students are more engaged in learning and have the opportunity to collaborate with classmates in finding solutions to given problems. In a study by Deswita (2020), it was concluded that teaching aids elicit a positive response in motivating students and provide visually appealing displays that facilitate understanding of the material. Another conclusion is that the use of teaching aids stimulates students' curiosity and enhances their involvement in learning. Consequently, students

who use teaching aids tend to be more active and enthusiastic in addressing problems and find it easier to recall the learned material. This refutes the belief held by some students that mathematics is difficult, as they are able to understand and answer questions easily after the learning session. After being aware of the claims and answers made by pupils pursuing arithmetic. One may argue that employing a stick board for instruction is a more relevant, productive, and efficient method for teaching in the twenty-first century. This is due to the fact that 21st century learning comprises four key components: 1) Communication: With the use of instructional aids, students can visually convey their ideas to classmates and teachers. This not only helps students understand the concepts being taught but also facilitates effective communication among peers and with teachers; 2) Collaboration: Through the use of instructional aids, students can collaborate in groups to solve problems, design projects, or prepare presentations. They can share ideas, debate solutions, and learn from each other. This collaborative process develops teamwork skills and prepares students to work in teams in the real world; 3) Critical Thinking and Problem Solving: When using instructional aids, students are encouraged to formulate questions, identify patterns, or analyze information. They are given the opportunity to question assumptions, evaluate evidence, and make decisions based on critical thinking. This sharpens analytical thinking skills and problem-solving skills crucial for facing 21st-century challenges; 4) Creativity and Innovation: The use of instructional aids enables students to express their ideas creatively. They can develop new solutions to complex problems, find innovative ways to illustrate difficult concepts. Similar findings were found by [Azzahra, et al. \(2023\)](#) which states that 21st-century learning elicits a positive response in various aspects such as critical thinking, innovation, and problem-solving. Additionally, they also stated that using this approach in learning also aids in developing students' creativity, enhancing information literacy, and fostering their sense of responsibility towards the learning process. This indicates that 21st-century learning can provide valuable contributions in preparing students to meet the demands of an ever-changing and complex world.

Educators can integrate instructional aids, such as prop stick boards, into their teaching practices in several ways. First, they use stick boards as visual aids to support students' understanding of difficult mathematical concepts, such as addition and subtraction with fractions or decimals. Next, they design activities that require students to directly use stick boards, such as problem-solving or exploring mathematical concepts. With this integration, educators can provide concrete learning experiences, facilitating students' understanding of mathematical concepts ([Ukobizaba et al., 2021](#)). To enhance effectiveness, educators align stick board usage with the curriculum, provide good training on usage to students, and encourage structured reflection. This helps students develop mathematical thinking skills and deepen their understanding of mathematical concepts.

Research shows that the use of teaching aids containing numerical pattern material can

increase students' enthusiasm for learning and help transform their understanding of abstract concepts about numbers into more concrete ones. This is demonstrated by the improvement in students' pretest and posttest results after studying numerical pattern material. The learning process, which is explained and practiced directly by students with the assistance of teaching aids, also supports students' understanding. Based on research conducted by (Hidayati & Munandar, 2023), learning tailored to students' interests can enhance their understanding of the material. Therefore, an approach to learning that utilizes teaching aids with numerical pattern material can enhance learning effectiveness. Additionally, students also benefit from the learning process itself, such as the development of critical skills and problem-solving abilities.

On the other hand, additional research indicates that students' satisfaction level with quality learning contributes to their positive response to the learning process. A study conducted by Aminulloh dan Widodo (2018) stated that students who feel satisfied and happy after completing quality learning tend to show positive responses. Thus, the use of teaching aids with numerical pattern material can provide a positive contribution to students' learning motivation, conceptual understanding, as well as their satisfaction and response to the learning process.

CONCLUSION

The implementation of teaching aids in mathematics class improves students' learning outcomes by more than 10%. This can be seen from the increase in scores from the pre-test to the post-test, where initially students' scores of 32 became 80 and students' scores of 60 became 80. Second-grade students in Joho Village are motivated and successfully understand number patterns with the help of stick boards. Pretest and posttest results show significant improvement. Children aged 7 to 11 find it easier to grasp material presented concretely through this tool. Additionally, the use of stick boards helps students think logically, remember, and articulate lesson content. Students' enthusiastic reactions indicate a strong curiosity and active participation in class activities. It is recommended to implement aids in classrooms to enhance mathematics learning, especially for topics considered challenging.

DECLARATIONS

Author Contribution : FA: Conceptualization, Writing-Original draft, Methodology, Editing, and Visualization; MP: Writing – Review, Formal analysis and Supervision; NH: Writing – Review, Formal analysis , Validation, and Supervision; WW: Conceptualization, Writing – Review ,Validation, and Supervision.

Funding Statement : -
Conflict of Interest : The authors declare no conflict of interest.
Additional Information : Additional information is available for this paper.

REFERENCES

- Amaliyah, A., Rini, C. P., Hartantri, S. D., & Yuliani, S. (2021). Analisis kesulitan belajar matematika siswa kelas V SD Negeri Taman Cibodas Kecamatan Periuk Kota Tangerang [analysis of mathematics learning difficulties of fifth grade students at Taman Cibodas Elementary School, Periuk District, Tangerang City]. *Indonesian Journal of Elementary Education (IJOEE)*, *2*(2), 11-20. <https://jurnal.umt.ac.id/index.php/IJOEE/article/view/3228/2094>
- Aminulloh, A. M., & Widodo, W. (2018). Keefektifan alat peraga bunyi untuk meningkatkan motivasi belajar dan pemahaman konsep siswa [The effectiveness of audiovisual aids in enhancing students' learning motivation and understanding of concepts]. *PENSA : E-JURNAL PENDIDIKAN SAINS*, *6*(02). Retrieved from <https://ejournal.unesa.ac.id/index.php/pensa/article/view/23306>
- Annur, M. F., & Hermansyah, H. (2020). Analisis kesulitan mahasiswa pendidikan matematika dalam pembelajaran daring pada masa pandemi Covid-19 [Analysis of mathematics education students' difficulties in online learning during the COVID-19 pandemic]. *Paedagogia: Jurnal Kajian, Penelitian dan Pengembangan Kependidikan*, *11*(2), 195-201. <https://journal.ummat.ac.id/index.php/paedagogia/article/view/2544>
- Ariyanto, L., Tsalatsa, A. N., & Prayito, M. (2018). Analisis free orientation dan resilience mahasiswa pada mata kuliah pengembangan media pembelajaran matematika [Analysis of free orientation and resilience of students in the course of mathematics learning media development]. *JIPMat*, *3*(1), 29-36. Retrieved from <https://journal.upgris.ac.id/index.php/JIPMat/article/view/2419>
- Arsana, I. K., Suarjana, M., & Arini, N. W. (2019). Pengaruh penggunaan mind mapping berbantuan alat peraga tangga garis bilangan terhadap hasil belajar matematika [The influence of using mind mapping aided by number line manipulatives on mathematics learning outcomes]. *Jurnal Internasional Pendidikan Dasar*, *3*(2), 99-107. <https://doi.org/10.23887/ijee.v3i2.18511>
- Azzahra, D. B., Khalifah, M. A. Y., Santoso, P. J., Aryawijaya, M., & Setiawan, D. A. (2023). Pembelajaran berbasis digital dalam bentuk civic skills abad 21 [Digital-based learning in the form of 21st-century civic skills]. *Jurnal Literasi Digital*, *3*(3), 201-210. <https://doi.org/10.54065/jld.3.3.2023.366>

- Carless, D. (2022). From teacher transmission of information to student feedback literacy: Activating the learner role in feedback processes. *Active Learning in Higher Education*, 23(2), 143-153. <https://doi.org/10.1177/1469787420945845>
- Deswita, H. (2020). Respon siswa terhadap alat peraga laga Sumatri (ular tangga sudut istimewa-trigonometri) [Students' response to the Sumatri game props (special angle snake and ladder-trigonometry)]. *PYTHAGORAS: Jurnal Program Studi Pendidikan Matematika*, 9(1), 28-40. <https://doi.org/10.33373/pythagoras.v9i1.2306>
- Dolapcioglu, S., & Doğanay, A. (2022). Development of critical thinking in mathematics classes via authentic learning: an action research. *International Journal of Mathematical Education in Science and Technology*, 53(6), 1363-1386. <https://doi.org/10.1080/0020739X.2020.1819573>
- Dron, J. (2022). Learning, Technology, and Technique. *Canadian Journal of Learning and Technology*, 48(1). <https://doi.org/10.21432/cjlt28315>
- Fikri, M., Arjudin, A., Hikmah, N., & Kurniati, N. (2022). Analisis kesalahan siswa dalam mengoneksikan konsep matematika pada materi pola bilangan kelas VIII MTs Dakwah Islamiyah Putra Nurul Hakim Kediri tahun ajaran 2018/2019 [Analysis of students' errors in connecting mathematical concepts in the topic of number patterns for the 8th grade at MTs Dakwah Islamiyah Putra Nurul Hakim Kediri in the academic year 2018/2019]. *Griya Journal of Mathematics Education and Application*, 2(3), 679-690. <https://doi.org/10.29303/griya.v2i3.184>
- Fitria, A. (2014). Penggunaan media audio visual dalam pembelajaran anak usia dini [The use of audiovisual media in early childhood learning]. *Cakrawala Dini: Jurnal Pendidikan Anak Usia Dini*, 5(2). <https://doi.org/10.17509/cd.v5i2.10498>
- Gallagher, M. A., Parsons, S. A., & Vaughn, M. (2022). Adaptive teaching in mathematics: A review of the literature. *Educational Review*, 74(2), 298-320. <https://doi.org/10.1080/00131911.2020.1722065>
- González-Pérez, L. I., & Ramírez-Montoya, M. S. (2022). Components of Education 4.0 in 21st century skills frameworks: systematic review. *Sustainability*, 14(3), 1493. <https://doi.org/10.3390/su14031493>
- Goos, M., Stillman, G., Herbert, S., & Geiger, V. (2020). *Teaching secondary school mathematics: Research and practice for the 21st century*. Routledge. <https://doi.org/10.4324/9781003117810>
- Hidayati, H. A., & Munandar, D. R. (2023). The Influence of mathematics learning interest on the conceptual understanding of eighth-grade middle school students. *Union: Jurnal*

- Jablonka, E. (2020). Critical thinking in mathematics education. *Encyclopedia of mathematics education*, 159-163. https://doi.org/10.1007/978-3-030-15789-0_35
- Khaeruddin. (2007). Kurikulum tingkat satuan pendidikan konsep dan implementasinya di madrasah [The curriculum at the unit level in education: concepts and its implementation in madrasah]. Jogjakarta: Pilar Media.
- Khotimah, R. P., Adnan, M., Ahmad, C. N. C., & Murtiyasa, B. (2021, February). Science, mathematics, engineering, and mathematics (STEM) education in Indonesia: a literature review. In *Journal of Physics: Conference Series* (Vol. 1776, No. 1, p. 012028). IOP Publishing. <https://doi.org/10.1088/1742-6596/1776/1/012028>
- Milles, M. B., & Huberman, A. M. *Analisis data kualitatif [Qualitative data analysis]*. Jakarta: Universitas Indonesia Press, 1992, hlm. 16.
- Murdiyanto, T., & Mahatama, Y. (2014). Pengembangan alat peraga matematika untuk meningkatkan minat dan motivasi belajar matematika siswa sekolah dasar [The development of mathematics teaching aids to enhance students' interest and motivation in learning mathematics at elementary school]. *Sarwahita*, 11(1), 38-43. <https://doi.org/10.21009/sarwahita.111.07>
- Niño, P. K. J. (2015). Exploring students' reactions when working teaching materials designed on their own interests. *Cuadernos de Lingüística Hispánica*, (25), 201-222.
- Piaget, J., & Cook, M. (1952). *The origins of intelligence in children* (Vol. 8, No. 5, pp. 18-1952). New York: International Universities Press. <https://psycnet.apa.org/doi/10.1037/11494-000>
- Russeffendi, E.T., et al. (1996). *Pendidikan Matematika [Mathematics education]*. (Jakarta: Depdikbud, 1996), hlm. 227- 230.
- Supriyono, S. (2018). Pentingnya media pembelajaran untuk meningkatkan minat belajar siswa SD [The importance of instructional media in enhancing elementary students' learning interest]. *Edustream: Jurnal Pendidikan Dasar*, 2(1), 43-48. <https://doi.org/10.26740/eds.v2n1.p43-48>
- Suardi, S., Firmiana, M. E., & Rohayati, R. (2016). Pengaruh penggunaan alat peraga terhadap hasil pembelajaran matematika pada anak usia dini [The effect of using teaching aids on the learning outcomes of early childhood mathematics]. *Jurnal Al-Azhar Indonesia Seri Humaniora*, 2(4), 297-305. <http://dx.doi.org/10.36722/sh.v2i4.177>

- Ukobizaba, F., Ndiokubwayo, K., Mukuka, A., & Uwamahoro, J. (2021). From what makes students dislike mathematics towards its effective teaching practices. *Bolema: Boletim de Educação Matemática*, 35, 1200-1216. <https://doi.org/10.1590/1980-4415v35n70a30>
- Unaenah, E., Putri, R. S., & Safitri, S. (2023). Pemanfaatan penggunaan alat peraga pada materi bangun ruang di sekolah dasar [The utilization of using teaching aids for spatial structures in elementary school]. *Seroja: Jurnal Pendidikan*, 2(4), 78-88. [h` ttps://doi.org/10.572349/seroja.v2i4.807](https://doi.org/10.572349/seroja.v2i4.807)

LAMPIRAN-LAMPIRAN

BIODATA PENULIS

Nama : Fika Ariana
TTL : Jepara, 23 Mei 2001
Agama : Islam
Alamat : Ds. Wedelan RT 02/10 Kec. Bangsri Kab. Jepara Prov. Jawa Tengah
Pendidikan : S-1 Pendidikan Matematika (Universitas PGRI Semarang)
Telp/ WA : 089648067871
Email : fikaariana12@gmail.com

PERNYATAAN KESEDIAAN SEBAGAI PEMBIMBING KTI

Yang bertanda tangan di bawah ini

- 1) Nama : Dr. Muhammad Prayito, M.Pd.
- 2) NIP/NPP : 11860133 , dan
- 3) Nama : Nurina Happy, S.Pd., M.Pd.
- 4) NIP/NPP : 148901448

menyatakan kesediaan sebagai pembimbing I dan pembimbing II karya tulis ilmiah mahasiswa, Nama : Fika Ariana
NPM : 20310048

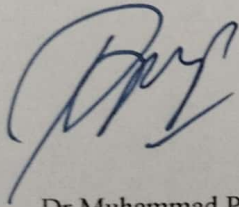
Judul KTI : The Use Of Teaching Props To Improve Mathematics Learning Outcomes In Number Pattern Material In STEM Village Yogyakarta

serta sanggup menjalankan prosedur pembimbingan KTI dengan penuh tanggung jawab.

Semarang, 4 April 2024

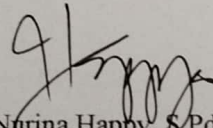
Yang menyatakan

Pembimbing I



Dr. Muhammad Prayito, M.Pd.
NPP 118601333

Pembimbing II



Nurina Happy, S.Pd., M.Pd.
NPP 148901448



LEMBAR PEMBIMBINGAN ARTIKEL

Nama Mahasiswa : FIKA ARIANA

NPM : 20310048

Prodi : Pendidikan Matematika

Judul Artikel : The Use Of Teaching Props To Improve Mathematics Learning

Outcomes In Number Pattern Material In STEM Village Yogyakarta

Dosen Pembimbing I : Dr. Muhammad Prayito, S.Pd.,M.Pd.

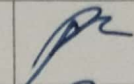
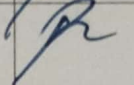
No	Hari, tanggal	Uraian Bimbingan	Paraf
1.	Senin, 3 April 2023	Pembahasan topik KTI dan pemilihan judul (Penggunaan Alat Peraga Untuk Meningkatkan Hasil Belajar Matematika Pada Materi Pola Bilangan di Desa STEM Yogyakarta)	
2.	Rabu, 5 April 2023	Bimbingan lebih lanjut tentang metode yang digunakan (kualitatif)	
3.	Senin, 10 April 2023	Bimbingan tentang draft kerangka artikel secara umum (judul tetap, metode, pendekatan, tujuan , rumusan masalah)	
4.	Kamis, 13 April 2023	Bimbingan tentang isi dari angket yang digunakan dalam penelitian (pre-test, post test, observasi, wawancara)	
5.	Jum'at, 28 April 2023	Diskusi hasil fiks tentang isi dari angket yang digunakan dalam penelitian (pre-test, post test, observasi, wawancara)	
6.	Senin, 24 Juli 2023	Bimbingan dan pemaparan dari hasil penelitian	
7.	Kamis, 27 Juli 2023	revisi hasil penelitian dan pembahasan (kurang data pada artikel)	
8.	Jumat, 25 Agustus 2023	Pembahasan dan pengecekan draft akhir KTI	
9.	Kamis, 1 Febuari 2024	Penyetoran draft akhir KTI fix	
10.	Jum'at, 16 Febuari 2024	Bimbingan revisi dari editor Jurnal (Bagian pendahuluam s.d Kesimpulan)	



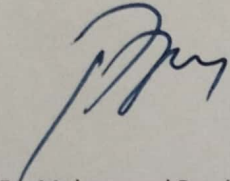
UNIVERSITAS PGRI SEMARANG
FAKULTAS PENDIDIKAN MIPA DAN TEKNOLOGI INFORMASI

Kampus: Jl. Dr. Cipto – Sidodadi Timur No.24 Semarang Indonesia

Tlp. (024) 8316377 Faks. (024)8448217 Email: upgrismg@gmail.com Homepage: www.upgris.ac.id

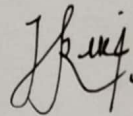
11.	Kamis, 22 Febuari 2024	Bimbingan revisi dari editor Jurnal (Bagian daftar pustaka)	
12.	Jum'at, 1 Maret 2024	Submit final KTI	

Dosen Pembimbing I



Df. Muhammad Prayito, M.Pd.
NPP 118601333

Mahasiswa



Fika Ariana
20310048



LEMBAR PEMBIMBINGAN ARTIKEL

Nama Mahasiswa : FIKA ARIANA

NPM : 20310048

Prodi : Pendidikan Matematika

Judul Artikel : The Use Of Teaching Props To Improve Mathematics Learning

Outcomes In Number Pattern Material In STEM Village Yogyakarta

Dosen Pembimbing II : Nurina Happy, S.Pd., M.Pd.

No	Hari, tanggal	Uraian Bimbingan	Paraf
1.	Senin, 3 April 2023	Pembahasan topik KTI dan pemilihan judul (Penggunaan Alat Peraga Untuk Meningkatkan Hasil Belajar Matematika Pada Materi Pola Bilangan di Desa STEM Yogyakarta)	
2.	Rabu, 5 April 2023	Bimbingan lebih lanjut tentang metode yang digunakan (kualitatif)	
3.	Senin, 10 April 2023	Bimbingan tentang draft kerangka artikel secara umum (judul tetap, metode, pendekatan, tujuan , rumusan masalah)	
4.	Jum'at, 14 April 2023	Bimbingan tentang isi dari angket yang digunakan dalam penelitian (pre-test, post test, observasi, wawancara)	
5.	Senin, 1 Mei 2023	Diskusi hasil fiks tentang isi dari angket yang digunakan dalam penelitian (pre-test, post test, observasi, wawancara)	
6.	Senin, 24 Juli 2023	Bimbingan dan pemaparan dari hasil penelitian	
7.	Jum'at, 28 Juli 2023	Bimbingan lanjutan (revisi hasil penelitian dan kesalahan pengetikan/ typo)	
8.	Jumat, 25 Agustus 2023	Pembahasan draft akhir KTI dan pengecekan plagiasi	
9.	Jum'at, 2 Februari 2024	Penyetoran draft akhir KTI fix dan pendampingan submit ke jurnal UNION Shinta 4	
10.	Jum'at, 16 Februari 2024	Bimbingan revisi dari editor Jurnal (Bagian pendahuluam s.d Kesimpulan)	
11.	Kamis, 22 Februari 2024	Bimbingan revisi dari editor Jurnal (Bagian daftar pustaka)	

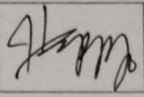


UNIVERSITAS PGRI SEMARANG

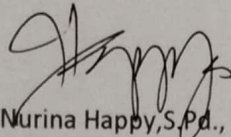
FAKULTAS PENDIDIKAN MIPA DAN TEKNOLOGI INFORMASI

Kampus: Jl. Dr. Cipto – Sidodadi Timur No.24 Semarang Indonesia

Tlp. (024) 8316377 Faks. (024)8448217 Email: upgrismg@gmail.com Homepage: www.upgris.ac.id

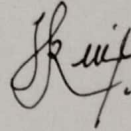
12.	Jum'at, 1Maret 2024	Submit final KTI	
-----	------------------------	------------------	---

Dosen Pembimbing I



Nurina Happy, S.Pd., M.Pd.
NPP 148901448

Mahasiswa



Fika Ariana
20310048



BERITA ACARA UJIAN DISEMINASI ARTIKEL KTI

Pada hari ini Kamis 04 April 2024, berdasarkan susunan tim penguji Diseminasi Artikel Publikasi KTI :

1. Nama : Dr. Supandi, S.Si., M.Si
Jabatan : Ketua
2. Nama : Dr. Muhammad Prayito, S.Pd., M.Pd.
Jabatan : Sekretaris
3. Nama : Dr. Muhammad Prayito, S.Pd. M.Pd
Jabatan : Anggota (Penguji I)
4. Nama : NURINA HAPPY, S.Pd., M.Pd
Jabatan : Anggota (Penguji II)
5. Nama : Dr. LUKMAN HARUN, S.Pd, M.Pd
Jabatan : Anggota (Penguji III)

Dengan ini menyatakan bahwa mahasiswa mahasiswa yang tersebut di bawah telah didiseminasikan artikel publikasinya.

Nama : Fika Ariana
N.P.M : 20310048
Fakultas : FPMIPATI
Program Studi : Pendidikan Matematika
Program Pendidikan : Strata 1

Judul Artikel :
THE USE OF TEACHING PROPS TO IMPROVE MATHEMATICS LEARNING OUTCOMES IN NUMBER
PATTERN MATERIAL IN STEM VILLAGE YOGYAKARTA

Nilai :

Demikian berita Acara Diseminasi artikel publikasi KTI dibuat untuk diketahui dan dipergunakan seperlunya oleh pihak-pihak yang berkepentingan.

Ketua,

Dr. Supandi, S.Si., M.Si

Sekretaris,

Dr. Muhammad Prayito, S.Pd., M.Pd.

Penguji Diseminasi I,

Dr. Muhammad Prayito, S.Pd. M.Pd

Penguji Diseminasi II,

NURINA HAPPY, S.Pd., M.Pd

Penguji Diseminasi III,

Dr. LUKMAN HARUN, S.Pd, M.Pd

Mengetahui,
Dekan,

Dr. Supandi, S.Si., M.Si
NPP/NIP 097401245

