

Article The Role of Visual Learning Style on Mathematics Comprehension Grade 2 Elementary School: A Qualitative Study

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Abstract

This study investigates how visual learning techniques can improve second-grade elementary kids' understanding of arithmetic. A teacher from SDN Ngadirejo 1 in Malang Regency participated in the study, which was carried out using a qualitative descriptive methodology. In-depth interviews were used to gather the data, and the Miles and Huberman model which comprises data reduction, data display, and conclusion drawing was used for analysis. The results show that students' comprehension of mathematical ideas is positively impacted by visual learning techniques. When information were given using visual aids like images, videos, and vibrant worksheets, students demonstrated more interest, quicker recall, and enhanced comprehension. However, verbal communication exercises and written exams were frequently challenging for students who prefer visual aids. Teachers used innovative techniques including peer explanations, visual-based tests, and outdoor learning exercises to solve this. These findings demonstrate the value of using visual aids in arithmetic lessons and imply that early school learning outcomes can be improved by customizing teaching strategies to each student's preferred learning style.

1. Introduction

Mathematics is a basic skill that students must possess because it plays a significant role in many aspects of life. Mathematics as "The Queen of Science" which means that it can stand alone for the development of mathematics itself and as a servant of science, which means that mathematics helps the development of other sciences, both exact sciences and social sciences along with technological advances. Seeing the importance of mathematics, students are required to study it seriously so that they have good and even satisfactory learning outcomes.

The reality is that many students have difficulty learning math, poor performance, and are slow to complete assignments. We can classify these students as students who have learning difficulties. This difficulty can be caused by several factors, both internal factors such as learning attitudes, learning motivation, study concentration, intelligence, and interests. There are external factors such as teachers, facilities and infrastructure, students' social environment, and family. Aligned with research (Saputra 2024), the learning process in elementary school can build a strong foundation of mathematical understanding for students. Because students' failure to understand basic concepts since basic education can have an impact on their difficulties in learning at a higher level.

1. Learning Style Theory

Student learning style is one of the important components in successful learning. According to (Bire, Geradus, and Bire 2019) The right learning style is the easiest way for a person to absorb, organize, and process the information they learn. Choosing the right learning style is essential for student success. Everyone has a unique way of ingesting, processing, and understanding data. A person's learning style can affect how effectively they learn. Understanding students' learning styles in math can help teachers change teaching strategies to better suit students' needs. In the teaching process, teachers must understand students well, including their abilities, interests, and limitations. Teachers must also know the learning style of students so that what is taught can be adjusted to the needs of students. Since learning styles are part of an individual's characteristics, understanding a student's learning style is not difficult. In other words, a student's learning style reflects their character and abilities.

2. Visual vs Auditorial Learning Style

Visual and auditory learning styles are the two most common. The visual learning style relies on vision, with a focus on images, graphics, colors, and conceptual visualization. Students who use visual media such as diagrams or illustrations tend to understand the material more easily. Auditory learning

styles rely on hearing, with students learning better through discussions, lectures, or recordings. Every learning style has its advantages and disadvantages, so it's important to tailor the learning method to the student's preferences.

3. Math and Visual Learning

In addition to learning styles that affect students' success in learning mathematics, there are other factors, such as teachers, learning facilities, and learning environment (Andri, Dores, and Lina 2020). All of these factors influence each other and are closely related to each other. Students have different opinions about math. There are positive and negative perspectives, this can be seen in students' daily activities, including learning and completing tasks that teachers give them. Students' differences in perspectives can be influenced by their learning experiences. This can happen because the teacher is unfriendly, there are too many assignments, poor math grades, or the math itself is considered difficult to understand. So, students face a lesson that has created a special experience for them. The educational experience at the next level will change or remain depending on the student's condition and other factors outside of the student.

Good understanding cannot be achieved if students do not take advantage and show a serious attitude in learning, even though the teaching staff and learning facilities are very good. Understanding mathematics is more influenced by the students themselves. Students are the main subjects in determining their attitudes and paths in learning. If there are no good teaching staff and facilities, students will not study well.

Although many studies have addressed learning styles and mathematical comprehension, the research that has been done on learning styles and mathematical comprehension is still lacking in identifying how visual learning styles contribute to the math comprehension of elementary school students. Therefore, this study aims to fill this gap by identifying how visual learning styles contribute to students' mathematical comprehension and how teachers can use them to improve their comprehension.

4. Theoretical Foundation

In order to maximize pupils' academic achievement, particularly in challenging disciplines like mathematics, learning styles are essential components. Individuals have preferred ways of processing information, such as kinesthetic, auditory, or visual, according to Fleming's VAK model (2001). Visual aids like charts, graphs, colors, and spatial arrangements help visual learners process and remember information more efficiently. This idea offers a fundamental perspective for comprehending how some students interact with knowledge more successfully when it is presented graphically.

Fleming's hypothesis is the main lens through which this study looks at how visually-oriented students react to visual teaching methods such using pictures, vibrant worksheets, and animated films when learning math. By being aware of these preferences, teachers can better adapt their teaching strategies to the learning styles of their pupils, which may enhance understanding and retention.

In addition, learning happens in three stages, according to Bruner's Theory of Representation (1966): enactive (action-based), iconic (image-based), and symbolic (language-based). Because it highlights the value of mental images and visual symbols in acquiring abstract concepts, like those found in mathematics, the iconic stage is especially pertinent to our study. According to Bruner's thesis, visual aids can serve as a bridge to help students go from tangible experiences to abstract comprehension. In order to understand how visual learning strategies might be used successfully in basic mathematics classrooms and why they might enhance students' comprehension, this research is guided by the combined models of Fleming and Bruner.

Table 1. of Synthesis of Previous Research

Researchers	Researcher Focus	Key Findings	Weaknesses or Gaps
(Bire et al. 2019)	Learning style and learning effectiveness.	Learning style has a significant effect on comprehension	Not yet focused on visual style
(Saputra 2024)	Elementary mathematics learning	Basic learning affects the next level	Not discussing learning styles

(Andri et al. 2020)	Factors of learning success	Learning style is one of the important factors	Haven't delved into the type of learning style
This research	Learning style in elementary mathematics comprehension	Focus on visual learning contribution	Fill in the gaps of previous research.

Based on the above background, this study will answer the following problem questions: What is the role of visual learning style on the understanding of mathematics of elementary school students?. So, based on the formulation of the problem, the purpose of this study is to identify how visual learning styles affect the understanding of mathematics of elementary school students, and provide recommendations to teachers on learning strategies that can support students with visual learning styles to better understand mathematical concepts.

2. Method

This study uses a descriptive qualitative approach with the aim of understanding in depth how visual learning styles play a role in the understanding of mathematics of elementary school students, especially grade 2 students, especially at SDN Ngadirejo 1 Malang Regency. The subject in this study is a 2nd grade teacher at SDN Ngadirejo 1, who has direct experience in applying various learning styles in mathematics learning. This teacher has been teaching mathematics at the elementary grade level for more than ten years. In addition, he is known to be active in implementing various learning approaches, including adapting teaching methods to students' learning styles. The choice of this informant is based on the belief that experienced and critically thinking teachers can provide in-depth and relevant information about the application of visual learning styles in mathematics learning.

Data was collected through in-depth interviews with teachers conducted directly at school interviews lasted approximately 45 minutes. The tools used were a semi-structured interview guide based on Fleming's (2001) visual learning style theory and Bruner's visual mathematics learning model. It includes identifying student characteristics using visual learning styles, teacher learning strategies for visual students, the influence of strategies on mathematical comprehension, and challenges faced. Included were some interview questions: How can you tell which pupils prefer visual learning? What types of visual materials or strategies do you use during math lessons? What difficulties do you see while applying visual learning strategies?

Using the model of Miles and Huberman (1994), the data collected was analyzed in three stages, data reduction, data presentation, and conclusion drawn. Researchers simplified the interview data, compiled it into stories, and then drew conclusions based on the observed patterns. The researcher uses source triangulation and validation with participants to ensure that the information conveyed is in accordance with the source's original experience to ensure the validity of the data. Ethical considerations were handled by gaining approval from the school administrator and securing the informed assent of the participating teacher. Anonymity and the freedom to leave the study at any time were guaranteed to the participant.

3. Results and Discussion

They should be combined. The study results should be clear and concise. Restrict the use of tables and figures to depict data that is essential to the message and interpretation of the study. The results should be presented in a logical sequence in the text, tables and illustrations. The part of result exposes the findings obtained from research data which is related to the hypotheses. The results should summarize (scientific) findings rather than providing data in great detail. The discussion should explore the significance of the results of the work. Explains the findings obtained from research data along with theory and similar research comparison. Make the discussion corresponding to the results, but do not reiterate the results. The following components should be covered in discussion: How do your results relate to the original question or objectives outlined in the Introduction section (what/how)? Do you provide interpretation scientifically for each of your results or findings presented (why)? Are your results consistent with what other investigators have reported (what else)? Or are there any differences?. Include in the discussion the implications of the findings and their limitations, how the findings fit into the context of other relevant work, and directions for future research.

3.1. Results

The results of interviews with grade 2 teachers at SDN Ngadirejo 1 show that recognizing students' learning styles, especially visual learning styles, is carried out through direct observation during learning. Teachers found that students who used visual learning styles were particularly interested in visual aids such as color images and videos. "Children are more interested if they learn to use visual aids such as pictures, videos and songs, especially if there is a color, they are immediately enthusiastic," said Teacher A. Meanwhile, students who use kinesthetic learning styles, on the other hand, seem disinterested and tend not to pay attention when visual media is used.

Teacher A said, "Visual media is very helpful for students to understand memorization materials such as multiplication and division. For example, when singing multiplication, they memorize and understand it faster." Singing videos that contain math materials and LKPD that are full of pictures, colors, and graphics are examples of media that are often used in math learning. Students will be very active to ask questions and practice the way explained directly, because the information is conveyed in an interesting and easy to understand manner. The use of this media makes students remember and understand the material faster. When the learning style is not suitable, students will tend not to pay attention, and when it is reapplied, they will still not understand the material explained, because when the learning style is not suitable for the students, of course they will not pay attention to the educator when explaining with the learning style.

Adapting the material to fit the visual learning style, which is typically used by teachers with the LKPD, also known as the Learner Worksheet, as the LKPD includes many visual learning elements, such as pictures, diagrams, graphs, and illustrated colors. So, students will be more interested in participating in the lesson. Students will definitely understand better with visual learning. However, it is possible that other learning methods will also have better results. As I said before, mathematics is a very limited science, so visual and kinesthetic learning methods will definitely be better for learning.

The right methods and approaches for visual learning, especially for mathematics learning, because mathematics is usually taught with numbers and basic rules and patents, teachers usually use memorization, for example such as multiplication and division. However, because they use a visual learning style, teachers often present by providing memorization videos by singing. In terms of the effectiveness of visual learning, teachers say that this method is very effective because it allows students to use their imagination to see the material taught during learning, so we can also see the extent to which their imagination works.

Teacher A says "Visual learning allows students to use their creativity. It can be seen from the way students imagine the information provided and use it when working on assignments or problems". Apart from that, there are also challenges that arise, especially for students who are facing written exams that are presented in black-and-white without any eye-catching visual elements. Visual students often have difficulty understanding problems because they are used to colorful media and visualizations.

Teacher A also said "Students who use visual learning styles tend to be passive in verbal communication. Therefore, teachers try to help students with activities that remain visual-based but encourage communication, such as asking students to explain pictures to their friends or participating in quizzes and question and answer games. To add variety and maintain the students' enthusiasm for learning, learning outside the classroom is occasionally carried out with manual media such as drawing or singing together".

Indicators when students improve their understanding of visual learning styles, when they use visual learning styles where they have to memorize the existing material, they will understand and do assignments faster because they have already memorized and feel faster doing assignments. Every learning style has its challenges, especially those related to visual learning. Challenges such as the choice of words and what expressions to say arise because students with visual learning tend to be passive because they watch videos more often or work on assignments with colorful media. The limitations of existing resources, as educators, of course, must be more creative, such as making songs for students, songs that are relevant to the material that we will explain. Because the school's facilities are very adequate, the school is also very supportive of visual learning. It would be a shame if it wasn't used for visual learning styles.

To increase the effectiveness of learning with a visual style, teachers do not only watch videos, pictures, and graphics. They invite students to practice and communicate, but they have to adjust to visual learning styles. For example, using picture media, we can ask them to take turns explaining to their friends to improve their communication skills.

Next, the plans and innovations that we can do. Visual learning done outside the classroom is an example. However, given that we do it outdoors, using manual media, such as doing quizzes and singing, can be done by doing Q&A with friends. In addition, to train students to communicate with visual learning styles that tend to be less effective, so that even if students use this style, they will also be more expressive and can express what they say better.

Table 2. Recommended length of each section in the manuscript

No	Information	Total
1	Visual student identification	High interest in image and video media
2	Learning media	Singing video, LKPD taking pictures
3	Challenge	Difficulties on black-and-white exams, passive communication
4	Solution	Quizzes, explaining assignments, outdoor learning

None of these research examine the real-world classroom effects of visual learning styles on primary-level arithmetic knowledge, despite the fact that they offer fundamental insights. The goal of this study is to close that gap.

3.2. Discussion

3.2.1 Characteristics of students with visual learning styles

Students of SDN Ngadirejo 2 who use visual learning styles are very different in understanding subject matter, especially mathematics. Visually dominant students show great enthusiasm when learning is done with media such as color images, videos, and illustrated LKPD. Compared to learning with visual media, they are more focused, memorize faster, and solve problems more confidently. In contrast, if hands-on practice is not included in the learning process, students with visual learning styles tend to lose focus and become bored. In line with research (Muhammad Dasep, Risa Salsabila, and Melinda Ayu Azzahra 2023) This reinforces how important it is to know how students' learning styles are from the beginning.

Students with a visual learning style can imagine the object being studied when the material is presented visually, they can process information more efficiently. According to research (Hidayati 2019) An important component of students' visual learning style is visual eyes/vision, teachers' teaching methods should focus on students using media, inviting them to relevant objects, or showing the teaching aids directly to students. The mathematics scores of students with visual learning styles are higher than students with auditory learning styles in mathematics learning. In contrast to the findings of previous research, (Zannurain, Rezeki, and Harahap 2023) Compared to students who use visual learning styles, students who use auditory learning styles have higher averages. Therefore, understanding the dominant learning style in each student can be the key to improving learning effectiveness. This will make the learning process better adapted to the needs of each student and more effective.

Students who have a visual learning style have the following characteristics. Good planners and organizers for the long term, meticulous to details, attentive to appearance, both in dress and presentation, good spellers and can see the actual words in their minds, remember what is seen rather than heard, usually remember with visual associations, prefer to read rather than be read, need a thorough perspective and purpose and be alert before mentally feeling certain about a problem or project, Scribbling meaninglessly during phone conversations and meetings, forgetting to deliver verbal messages to others, often answering questions with a short "yes" or "no" answer, and preferring to demonstrate. These findings are in line with the findings (Azis, Pamujo, and Yuwono 2020), there are several traits of visual learning styles, such as taking notes of material neatly and regularly, paying attention to detail, paying attention to appearance, remembering visual relationships, diligent readers, preferring to read rather than read.

3.2.2 The role of visual learning styles in elementary school students' understanding of mathematics

There is a strong correlation between visual learning styles and understanding of mathematical concepts, which is an important finding of this study. According to research (Tahta Aunillah et al. 2024) Students' learning styles greatly affect their abilities in mathematics. Students will have an easier time processing and absorbing material when they receive information that suits their dominant learning style. A learning approach that uses colors, shapes, and images for visual students makes the learning process more meaningful. To help students memorize multiplication, teachers can include illustrative pictures in practice questions or provide singing videos. The visual method has a real advantage. First, visual media improves students' memory because it makes information easier to remember. Second, abstract concepts such as division or fraction become easier to understand, and third, because visual media grabs students' attention and encourages them to ask questions or speak more actively.

In this study, it was found that students' understanding of mathematics taught through visual learning styles was better than those taught through auditory learning styles. In addition, it was found that the mathematics learning outcomes of students taught through visual learning styles were better than the learning outcomes of students taught through the learning community learning model. Shows that students taught through visual learning styles are better than students taught through auditory learning styles. Previous research has shown that visual learning style is positively correlated with understanding of mathematical concepts. (Pardosi 2020) It was found that the mathematics learning outcomes of students with a visual learning approach were better than those of students with an auditorial learning approach. (Larasati and Widyasari 2021) It was also found that students who used a visual learning approach had a higher learning rate than students who used an auditory learning approach. Therefore, it is evident that an approach that uses a visual learning style improves students' mathematical comprehension. This shows how important it is to consider different learning styles when creating more inclusive and effective learning strategies.

Visual learning style is closely related to improving understanding of mathematical concepts. When students receive information according to their learning preferences, they will find it easier to process and absorb the material presented. The teacher explained that visual students are greatly helped by the approach that uses colors, shapes, and pictures, so that the learning process becomes more meaningful. In accordance with research (Afnanda 2023), Verbal learners can quickly understand oral and written information, the dimension of information comprehension (sequential-global) refers to the preferred way of organizing information. One of the strategies is to provide singing videos to help students memorize multiplication, or insert illustrative pictures in practice questions to help students visualize the content of the questions. This strategy has been proven to increase students' absorption of abstract mathematical material.

Students who use different learning styles have different understanding of mathematics. It is shown by the difference in student understanding between students who use visual learning styles, with students who use auditory learning styles, and students who use kinesthetic learning styles. In line with research (Agata et al. 2024), shows that students who learn according to their learning style will find it easier to describe and apply the knowledge they learn, as well as show an improvement in their ability to think mathematically creatively. This difference can be seen as learning continues. All students have different learning styles, so teachers must be creative when teaching math because they must make the lessons fun for all students. According to what teachers see when teaching, there are differences between the three groups of students who use visual, auditory, and kinesthetic learning styles.

3.3.3 Visual learning strategies, challenges, and solutions for elementary school students

Supporting their visual learning style, teachers at SDN Ngadirejo 2 use various strategies and media. For example, pictures, graphs, manual props such as stereofoam radius, and learning videos containing counting songs. Each of these mediums is designed to fit a student's learning style, and has been shown to increase student engagement and interest in learning mathematics. To train visual students who tend to be verbally passive, teachers also use visual-based quiz and question and answer games. Simple media such as picture paper and songs are also used in learning outside the classroom to make lessons engaging. According to research (Sabrina et al. 2023) found that there is evidence that regular use of visual learning media improves the mathematical comprehension of elementary school students. Likewise, (Pardede, Ahmad, and Harahap 2021) reported that the learning outcomes of students who used visual learning styles tended to be better compared to students who used kinesthetic and auditory learning styles. In line with research (Rahmawati et al. 2023) stating that learning media is very important in primary education; Making it accessible is essential to improving student

achievement. This strategy shows that teachers' creativity can enable visual learning without relying on advanced technology.

In addition, the problems faced when using visual learning styles are an important concern. Teachers are often faced with issues such as time constraints, media, and different learning styles of students in a class. Therefore, a systematic and collaborative solution is needed. First, teachers must be trained in the use of visual-based learning strategies and the use of effective and creative media. Second, the curriculum should be made with flexibility so that teachers can tailor their approach to the needs of students. Third, collaboration with parents and the community must be built to ensure that the learning process of students does not stop at school but is also strengthened at home and in their own environment.

3.3. Conclusion

Based on the results of research at SDN Ngadirejo 2, it shows that visual learning style has a significant influence on how elementary school students understand mathematics. In the visual learning style, students are very interested in pictorial, colorful, and moving learning media such as videos. This encourages them to participate more actively in learning, especially memorization materials such as multiplication and division. However, they face difficulties in written exams that require verbal communication skills and lack visual elements. Therefore, teachers must adapt their learning methods to the visual learning style of students. This can be done by increasing the use of visual media, holding interactive quizzes, and including image elements in the assessment.

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It is recommended that teachers receive training to identify and develop teaching approaches based on students' learning styles. Further research should be conducted to determine the relationship between visual learning styles and other learning approaches in the context of mathematics learning. The study did not have many subjects, involved only one teacher as an informant and did not involve students directly. As a result, to get a more accurate and thorough picture, further exploration should be done by involving students directly. With this effort, it is hoped that students who use visual learning styles will achieve a better understanding of mathematics

Author Contributions

Desy Ari Sandi: Conceptualization, Methodology, Writing Original Draft Preparation. Candra Utama: Supervision, Writing – Reviewing.

All authors have equal contributions to the paper. All the authors have read and approved the final manuscript.

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