

Review Article

The Role of Teacher Communication in Mathematics Learning: A Literature Review

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ABSTRACT

Teacher communication plays an important role in the effectiveness of mathematics learning, especially in helping students understand abstract concepts. This study aims to analyze the role of teacher communication in improving students' understanding and motivation in mathematics learning. The method used is a literature review by analyzing various studies that discuss teacher communication in the context of mathematics education. The results of the study show that effective communication allows teachers to create an inclusive learning environment, increase student interaction, and build higher learning motivation. Verbal and nonverbal communication, the use of technology in teaching, and interpersonal communication strategies have been proven to have a positive impact on students' understanding of concepts and participation in learning. The implications of these findings emphasize the importance of communication training for mathematics teachers to optimize interaction with students. The recommendations given include the development of technology-based communication strategies, the application of more interactive communication methods, and the improvement of teachers' communication skills through continuous training.

Keywords: Teacher Communication; Mathematics Learning; Educational Interaction; Learning Motivation; Communication Strategy

1. INTRODUCTION

In the world of education, communication is one of the main pillars that supports the teaching and learning process, especially in mathematics subjects (Inah Ety Nur, 2015; Sugianto, 2022). Teachers, as leaders in the classroom, play a key role in determining the effectiveness of material delivery and student understanding. Good communication is not just about conveying information, but also involves educational interactions that are able to help students understand mathematical concepts that are often complex and abstract (Bjelland et al., 2015; Lee & SunWoo, 2011).

In the process of learning mathematics, the interaction between teachers and students is a very vital component. Quality interactions do not only occur spontaneously, but must be supported by clear objectives, planned procedures, and the development of specific materials (Cousin et al., 2012; Logan & Barrett, 2018). Clear objectives help students understand what is expected of them in each learning session, while well-planned procedures ensure that learning activities run smoothly and in a targeted manner. The development of specialized material allows teachers to present mathematical concepts in a way that can be understood by students, according to their level of understanding and individual needs.

Teachers, as leaders in the classroom, must be able to master various interaction patterns and effective communication techniques. This includes the ability to convey concepts clearly, provide relevant examples, and facilitate discussions that open up space for students to ask questions and share thoughts. Teachers who are proficient in communication can create an inclusive learning atmosphere, where every student feels valued and recognized. They can also use a variety of strategies, such as cooperative learning, group discussions, and practice activities, to ensure that students are actively involved in the learning process (Fornaciari et al., 2013; Solaja et al., 2016).

Some research (Guo et al., 2015; Luo et al., 2016; Men, 2015; Miles et al., 1990; Oliveira et al., 2022; Pesch et al., 2015; Sagie, 1996; Vance et al., 2008) shows that effective communication allows teachers to become mentors who help students develop critical and creative thinking skills. Through thought-provoking questions, teachers can invite students to analyze problems from different perspectives, find alternative solutions, and draw conclusions that are supported by evidence.

Dynamic interactions also encourage students to think creatively, find connections between different mathematical concepts, and apply their knowledge in diverse contexts. In addition, quality interaction increases students' motivation to learn. When students feel engaged and valued, they are more likely to actively participate in learning activities. High motivation helps students to be more focused, more responsible for their tasks, and more enthusiastic in exploring new mathematical concepts (Febbivoyna et al., 2021; Mahayasa, 2023). Teachers who are able to build positive relationships with students can help create a supportive learning environment, where students feel comfortable taking risks and learning from their mistakes.

Not only that, but the dynamic interaction process also plays an important role in developing students' social skills, which are an important component in collaborative learning. Through cooperation with peers, students learn to communicate effectively, share ideas, and work together in completing assignments. These social skills not only help students in an academic context, but they also prepare them to interact well in everyday life and in the workplace in the future (Chisholm et al., 2011; Jagers & Walgrave, 2007). So that the interaction between teachers and students in mathematics learning is not only about delivering material, but also about creating a learning environment that supports the holistic growth of students. Teachers who are able to utilize a variety of communication and interaction strategies can help students to reach their full potential, not only in math, but also in other aspects of their lives.

Furthermore, the interaction between teachers and students in mathematics learning plays a central role that not only functions as a tool for conveying information, but also becomes the foundation for the creation of a conducive, dynamic, and meaningful learning environment (Ana et al., 2019; Mulyati, 2019). In order for this process to run optimally, the interaction must have clear goals, well-planned procedures, and specific approaches to working on the material according to the needs of students. Teachers, as the main facilitators in the classroom, are required to master various interaction patterns and effective communication techniques so that they are able to create an inclusive, participatory learning atmosphere and support students' intellectual development. In the context of mathematics learning, effective communication is not only about conveying formulas or abstract concepts to students, but also guiding them to understand the meaning behind each of these concepts. Thus, teachers not only act as transmitters of knowledge, but also as guides who help students develop critical and creative thinking skills (Zhong & Ma, 2022).

To create effective communication in mathematics learning involves more than just verbal delivery of material; It also includes non-verbal aspects such as body language, facial expressions, and tone of voice that are able to build emotional connections between teachers and students. When a teacher is able to communicate mathematical ideas in an engaging and easy-to-understand way, students will feel more confident to actively engage in discussions, ask questions, and share their thoughts. This is important because mathematics is often considered a difficult and daunting subject by some students (Nugraheni et al., 2024; Rahayu et al., 2023; Setiyabudi, 2016). Therefore, the ability of teachers to present interactive and fun learning through appropriate communication can change these negative perceptions. In addition, through dynamic interactions, students not only learn to understand mathematical concepts individually, but also learn to work together in groups, collaborate on problem-solving, and develop social skills that are essential in everyday life.

Furthermore, effective communication also plays a role in increasing students' motivation to learn mathematics. A teacher who is able to relate the subject matter to real-life or situations that are relevant to students will make learning feel more meaningful. For example, when a teacher uses concrete examples from everyday life such as financial calculations, grocery measurements, or statistical analysis in sports, students will have an easier time understanding real-world applications of mathematics (Lestari & Feb. 2020; March 20, 2019). This approach not only improves students' understanding, but also arouses their interest in continuing to learn and explore further. On the other hand, poor or ineffective communication can cause students to feel alienated, frustrated, or even lose interest in math. Therefore, teachers' ability to communicate clearly, openly, and responsively is the key to success in mathematics learning.

In addition, effective communication also serves as a tool to monitor student progress and provide constructive feedback. Through open dialogue, teachers can find out the difficulties experienced by students, understand their way of thinking, and provide the right direction to overcome existing obstacles. Positive and supportive feedback will help students feel valued and motivated to continue learning (Gusteti et al., 2024). In this context, teachers must also be able to listen actively, namely by paying full attention to what students say, so that they feel heard and understood. This listening ability is very important because often students have a unique perspective or solution to a math problem, which if appreciated and supported well, can be a source of innovation and creativity in learning. Thus, the role of teacher communication in mathematics learning cannot be underestimated. Effective communication not only helps students understand the subject matter, but also creates a learning environment that supports the holistic development of students, both in terms of academic ability and social skills. Teachers who are able to master the art of communication in mathematics learning will be a catalyst for student success, helping them grow into critical, creative, and ready individuals to face the challenges of the modern world.

Some other research (Nasrulloh, 2016; Parinata et al., 2022; Priatna, 2016; Siregar, 2018) It also shows that communication in mathematics learning can serve as a tool to measure student understanding. Through the exchange of messages that occur in teacher-student interactions, teachers can reflect on students' understanding and adjust teaching strategies according to individual needs. This shows that communication is not only about conveying material, but also helps in evaluating and improving the learning process. Teachers who are able to communicate well can help students overcome learning difficulties, increase confidence, and create a positive and inclusive learning environment (Gallois et al., 1992). In today's digital era, communication between teachers and students is no longer limited to the classroom. The use of information and communication technology (ICT) allows for wider and more flexible interactions. However, while technology makes communication easier, it is still important to maintain a balance between the use of technology and direct interaction so that the relationship between teachers and students remains strong and meaningful. Face-to-face interaction allows teachers to better understand student needs and provide more personalized support, while technology can expand students' access to quality learning resources. Thus, the role of teacher communication in teaching mathematics cannot be ignored. Through effective communication, teachers can assist students in overcoming learning difficulties, increase motivation, and create a positive learning environment. Research on communication in mathematics learning shows that teachers who are able to communicate well can significantly affect student learning outcomes. Therefore, the development of teachers' communication skills should be a priority in education, so that they can play a more effective role in guiding students towards academic and personal success.

2. RESEARCH METHOD

This study uses a literature review method or library study with a systematic approach to identify, analyze, and synthesize research related to teacher communication, student communication, and mathematics learning. This study aims to understand the role of communication in improving the effectiveness of mathematics learning based on the findings of previous research. The literature search process was carried out using keywords such as "teacher communication in mathematics learning", "teacher-student interaction in mathematics class", and "the influence of communication on mathematics learning outcomes". Literature sources are drawn from academic databases such as Google Scholar, Scopus, SpringerLink, and ScienceDirect, with a focus on articles published in peer-reviewed scientific journals in the last 10 years. Only articles that directly address communication in mathematics learning are considered, while studies that are irrelevant or do not meet academic standards are excluded.

After the initial selection, the selected articles were analyzed descriptively by considering the research methods used, the study population, and the main findings related to the effectiveness of communication in mathematics learning. The data were then synthesized thematically based on categories such as the role of communication in building student understanding, the effectiveness of verbal and nonverbal communication, and the impact of interpersonal communication on student learning motivation. The results of the literature synthesis were used to identify research gaps related to communication in mathematics learning and provide recommendations for further research. In addition, this study also discusses limitations, such as the lack of research with experimental designs and the variability of communication approaches between teachers. Thus, this research is expected to provide insight into the importance of communication in mathematics learning as well as practical implications for the development of teacher communication strategies in the classroom.

3. RESULTS AND DISCUSSION

3.1. Definition of Teacher Communication

Teacher communication in learning is an interaction process involving teachers and students, where teachers act as facilitators who build effective and affective relationships to support student learning success. In this context, communication is not just about conveying information, but also includes the development of positive interpersonal relationships between teachers and students, which can increase students' motivation and understanding of the subject matter (Nurkhairina & Assingkily, 2023; Nirmala, 2021; Muskita, 2021). Effective communication in learning serves to create a conducive classroom climate, where students feel comfortable participating and interacting. This is important because good communication can affect students' motivation, as well as their learning outcomes. For example, research shows that students who have good communication with teachers tend to be more open and easier to understand the subject matter, which in turn improves their learning outcomes (Nirmala, 2021; Costa, 2022). In addition, effective communication also plays a role in successful classroom management, where teachers can facilitate positive interactions between students and create an inclusive learning environment (Juniarti, 2023; Muskita, 2021).

In the era of online learning that is increasingly developing, the role of teacher communication has become increasingly crucial. Teachers are required to adapt their communication methods to remain effective even in remote learning situations. Research shows that the use of information and communication technology (ICT) in online learning can improve interaction between teachers and students, despite challenges that must be faced, such as technical problems and limited access (Safitri & Retnasary, 2020; Apriansyah & Lindawati, 2023). Therefore, teachers' ability to communicate persuasively and adaptively is indispensable to maintain student motivation and engagement during the learning process (Costa, 2022; Christy & Oktavianti, 2021). Thus, teacher communication in learning is a key element that not only affects the teaching and learning process, but also has an impact on students' social and emotional development. By building good communication, teachers can create a more meaningful and effective learning experience for students (Nurkhairina & Assingkily, 2023; Sabbihisma, 2023; Yanti, 2019).

3.2. Types of Communication

In the study of communication, there are various types of communication that can be identified based on the context, purpose, and way of delivering the message. These types of communication have a significant role in various aspects of life, including in the context of education, business, and social interaction. In this study, we will discuss in depth the types of communication, which include verbal communication, non-verbal communication, written communication, visual communication, and digital communication. Each of these types of communication will be explained in detail, including their characteristics, examples, and relevance in daily life.

1) Verbal Communication

Verbal communication is a form of communication that involves the use of words, both verbally and in writing. In a verbal context, verbal communication occurs when individuals talk to each other, either in a face-to-face conversation or over the phone. Meanwhile, written verbal communication includes all forms of writing, such as letters, emails, and reports. One of the main characteristics of verbal communication is its ability to convey information directly and clearly. For example, in an educational setting, teachers use verbal communication to explain subject matter to students, provide instructions, and answer student questions. In verbal communication, intonation, speaking speed, and word selection also play an important role. Research shows that the way a person speaks can affect the listener's perception of the message conveyed. For example, the use of a positive tone of voice can increase the reception of messages, while a negative tone of voice can cause discomfort. Therefore, good verbal communication skills are essential for building effective and productive relationships, both in educational contexts and in everyday social interactions.

2) Non-Verbal Communication

Non-verbal communication includes all forms of communication that do not use words. These include facial expressions, body movements, eye contact, and body language. Non-verbal communication often provides additional context to the verbal message being conveyed. For example, a teacher who smiles while giving instructions can create a more positive and supportive atmosphere for students. Conversely, a closed posture or serious facial expressions can create tension in interactions. Research shows that non-verbal communication can convey emotions and feelings more powerfully than words. In the context of education, teachers need to be aware of the importance of non-verbal communication in creating a positive classroom climate. For example, good eye contact between teachers and students can increase student engagement in learning. Additionally, open and friendly body movements can help students feel more comfortable participating in class discussions.

3) Written Communication

Written communication is a form of communication that uses writing as a medium for conveying messages. It includes various forms, such as letters, reports, articles, and text messages. Written communication has an advantage in terms of precision and clarity, as messages can be carefully crafted before being delivered. In the context of education, written communication is often used in the form of assignments, papers, and class notes. One of the challenges in written communication is the risk of misunderstanding. In the absence of intonation or facial expressions, the reader may interpret the message in a different way than the writer intended. Therefore, it is important for the writer to use clear and precise language, and to structure the message well so that it can be understood by the reader. In the business world, effective written communication is also very important to ensure that information is conveyed clearly to all parties involved.

4) Visual Communication

Visual communication involves the use of images, graphics, and symbols to convey a message. This includes presentations, infographics, posters, and videos. Visual communication is very effective in attracting attention and facilitating the

understanding of complex information. In the context of education, teachers often use visual aids, such as whiteboards, presentation slides, and drawings, to clarify the subject matter. Research shows that humans tend to remember information that is conveyed visually more easily than information conveyed verbally. Therefore, the use of visual communication in learning can improve students' memory of the material being taught. In addition, visual communication can also help students with different learning styles, such as students who prefer to learn through visuals rather than through text.

5) *Digital Communication*

Digital communication includes all forms of communication carried out through digital media, such as email, social media, and instant messaging applications. In the era of increasingly advanced information technology, digital communication has become an integral part of daily life. In the context of education, digital communication allows teachers and students to interact more flexibly and efficiently. One of the advantages of digital communication is its ability to reach a wider audience. For example, teachers can use online learning platforms to teach students from different locations. However, digital communication also has its challenges, such as the risk of misunderstanding due to a lack of non-verbal communication and the potential for distractions from multiple sources. Therefore, it is important for individuals to develop good digital communication skills in order to interact effectively in a digital environment.

6) *Interpersonal Communication*

Interpersonal communication is a form of communication that occurs between two or more people in a social context. This includes everyday conversations, group discussions, and workplace interactions. Interpersonal communication is essential in building strong relationships and mutual understanding between individuals. In the context of education, interpersonal communication between teachers and students can affect student motivation and involvement in learning. One of the important aspects of interpersonal communication is the ability to listen. Active listening allows individuals to understand the perspectives of others and respond in appropriate ways. In an educational setting, teachers who are able to listen well to students can create a supportive and inclusive atmosphere, where students feel valued and heard.

7) *Group Communication*

Group communication occurs when a group of people interact to achieve a common goal. This includes group discussions, meetings, and collaboration on projects. In the context of education, group communication is often used in project-based learning, where students work together to complete specific tasks. Effective group communication can increase creativity and innovation, as individuals can share different ideas and perspectives. However, group communication can also face challenges, such as dominance by one or more individuals, or difficulties in reaching consensus. Therefore, it is important for group members to develop good communication skills, including the ability to negotiate and resolve conflicts. In an educational context, teachers can act as facilitators to help students manage group dynamics and ensure that all voices are heard.

8) *Formal and Informal Communication*

Formal communication is a form of communication that follows a specific structure and rules, such as in formal meetings, presentations, or reports. On the other hand, informal communication occurs in a more casual context, such as everyday conversations between friends or coworkers. In the context of education, formal communication often occurs in formal situations, such as parent-teacher meetings, while informal communication can occur outside the classroom, such as when students are talking in the cafeteria. Both types of communication have an important role in building relationships and conveying information. Formal communication can provide clarity and structure, while informal communication can strengthen interpersonal relationships and create a more intimate atmosphere. In the context of education, it is important for teachers to create a balance between formal and informal communication in order to build positive relationships with students.

9) *Cross-Cultural Communication*

Cross-cultural communication occurs when individuals from different cultural backgrounds interact. In an increasingly globalized world, the ability to communicate effectively with people from different cultures is becoming increasingly important. In the context of education, cross-cultural communication can occur in diverse classrooms, where students come from different ethnic and cultural backgrounds. One of the challenges in cross-cultural communication is differences in norms and values that can affect how individuals interact. For example, some cultures may value direct communication more, while others may prioritize more subtle and indirect communication. Therefore, it is important for individuals to develop cultural awareness and cross-cultural communication skills in order to interact effectively and respect existing differences. Therefore, communication is an important aspect of daily life that includes various types and forms. From verbal

and non-verbal communication to digital and cross-cultural communication, each type of communication has its own characteristics and relevance. In an educational context, a deep understanding of these types of communication can help teachers and students to interact more effectively, create a positive learning climate, and improve learning outcomes. Therefore, the development of good communication skills should be a focus in education, both for teachers and students, to facilitate productive interaction and mutual understanding.

3.3. The Role of Teacher Communication in Mathematics Learning

The role of teacher communication in mathematics learning is very important to create an effective learning environment and support the development of students' abilities. Good communication between teachers and students can improve their understanding of mathematical concepts, motivate students, and assist them in solving mathematical problems. In this context, we will discuss some important aspects of the teacher's communication role in mathematics learning, including effective communication strategies, the use of technology, and its impact on student motivation and engagement.

1) *Effective Communication Strategies*

Teachers need to use a variety of effective communication strategies to convey math material clearly and interestingly. One of the approaches that can be applied is cooperative learning methods, such as Think-Pair-Share (TPS), which have been proven to improve students' mathematical communication skills. Research shows that students who learn with the TPS method have better achievement of mathematical communication skills compared to students who learn with the expository method of Wahyuni et al. (2018). By engaging students in group discussions, teachers can encourage them to share their ideas and problem-solving strategies, which in turn improves their understanding of the material. In addition, the use of information and communication technology (ICT)-based learning media can also increase the effectiveness of communication in mathematics learning. Teachers can utilize digital applications and platforms to present materials interactively, so that students are more interested and involved in the learning process (Febriani et al., 2023). For example, the use of GeoGebra as a visual aid in geometry learning can help students understand concepts better (Randjawali et al., 2020). Thus, a combination of the right communication strategies and the use of technology can create a more enjoyable and effective learning experience for students.

2) *Building Positive Relationships*

Good communication also plays a role in building a positive relationship between teachers and students. Strong relationships can boost students' confidence and encourage them to participate more actively in learning. Research shows that students who feel comfortable communicating with teachers tend to be more motivated to learn and are better able to overcome difficulties in understanding the material (Munawaroh, 2021). Therefore, teachers need to create an inclusive and supportive classroom atmosphere, where students feel valued and heard. Teachers must also pay attention to the communication style of each student. Each student has a different way of understanding and conveying mathematical ideas. By recognizing these differences, teachers can tailor their communication approach to meet the individual needs of students, so that each student can contribute to class discussions (Umar, 2012). This not only improves students' understanding of the material, but also helps them develop the communication skills necessary in daily life.

3) *Use of Technology in Learning*

In today's digital era, the use of technology in mathematics learning is becoming increasingly important. Teachers must be able to utilize various digital tools and applications to support the teaching and learning process. For example, the use of learning applications such as PhotoMath or augmented reality-based learning applications can help students understand mathematical concepts in a more interactive and engaging way (Handayani & Solihah, 2022; Nurcahyo et al., 2022). In addition, online learning also provides opportunities for teachers to reach students outside the classroom, so that communication can take place more flexibly. However, challenges in online learning also need to be considered. Research shows that the lack of direct interaction between teachers and students can hinder the process of communication and student understanding of the material (Alfiansyah, 2023). Therefore, teachers need to develop good communication skills in the context of online learning, such as using video conferencing for live discussions or online learning platforms to share materials and assignments (Widayanti et al., 2021). Thus, the right use of technology can increase the effectiveness of communication in mathematics learning.

4) *Impact on Student Motivation and Engagement*

Effective communication also has a significant impact on student motivation and engagement in mathematics learning. When teachers are able to deliver material in an engaging and relevant way, students will be more motivated to learn and participate in learning activities. Research shows that students who feel engaged in learning tend to have better learning

outcomes (Azizah et al., 2021). Therefore, it is important for teachers to continue to look for innovative ways to deliver math material so that students remain enthusiastic and motivated. In addition, teachers also need to provide constructive feedback to students. Positive feedback can boost students' confidence and encourage them to continue learning. Research shows that timely and relevant feedback can help students understand their mistakes and improve their understanding of the material (Hermanto & Supena, 2021). Thus, the role of teacher communication in providing effective feedback is very important to support students' academic development. Therefore, the role of teacher communication in mathematics learning is crucial to create an effective learning environment and support student development. Through appropriate communication strategies, the use of technology, and positive relationship building, teachers can improve students' understanding of math material and encourage them to participate more actively in learning. Therefore, the development of teachers' communication skills must be the main focus in efforts to improve the quality of mathematics education.

4. CONCLUSION

Based on the literature review conducted, teacher communication has a very important role in increasing the effectiveness of mathematics learning. Good communication not only serves as a tool for conveying information, but also builds educational interactions that help students understand mathematical concepts in more depth. This study shows that effective communication—both verbal and nonverbal—contributes to creating an inclusive learning environment, increasing student motivation, and encouraging active participation in learning. In addition, the use of technology in teacher communication, such as the use of interactive media and digital platforms, has been proven to increase student engagement and make the material easier to understand. Teachers who have good communication skills are also able to guide students in critical, creative, and collaborative thinking, thereby improving their learning outcomes. To optimize the role of communication in mathematics learning, teachers are advised to continue to develop their communication skills through reflective training and practice. The use of more interactive communication strategies, such as group discussions and problem-based learning, can also be a solution in increasing the effectiveness of classroom interactions. Thus, effective communication not only supports students' academic achievements, but also builds social skills and logical thinking that will be beneficial in their lives.

RECOMMENDATION

Based on the results of the literature review, several recommendations can be given to improve the effectiveness of teacher communication in mathematics learning. First, teachers need to develop their communication competencies through training that includes interactive communication strategies, the use of clear language, and active listening techniques. This will help them deliver material more effectively and build better relationships with students. Furthermore, the use of technology in learning needs to be improved, such as the use of digital media, learning applications, and online discussion platforms, so that mathematics materials can be presented in a more interesting and easy-to-understand manner. In addition, teachers are advised to improve student interaction in the classroom by applying communicative learning methods, such as group discussions, problem-based learning, and cooperative approaches, so that students are more active in the learning process. Providing constructive feedback is also very important, where teachers need to convey clear, specific, and constructive feedback, and encourage two-way communication so that students are more confident in conveying their understanding and overcoming learning difficulties. Finally, further research is needed to explore the most effective teacher communication strategies in various mathematics learning contexts, including online and hybrid learning. By implementing these recommendations, it is hoped that mathematics learning will become more interactive, interesting, and effective, and be able to increase students' understanding and motivation in learning.

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