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ENHANCING LEARNERS' MATHEMATICAL COMMUNICATION SKILLS DURING TEACHING PRACTICE: PERCEPTIONS OF STUDENT TEACHERS

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ABSTRACT

Communication is central to the teaching and learning of mathematics in the classroom. This study aims to determine the extent to which learners possessed mathematical communication skills and the role that student teachers played to enhance these skills during teaching practice. Mathematical Communication Skills (MCS) refer to the students' capacity to (1) organize and connect their mathematical thinking through communication; (2) communicate their logical and clear mathematical thinking to their friends, teachers, and others; (3) analyze and assess other people's mathematical thinking and strategies; and (4) use mathematical language to express their ideas accurately. Learners' mathematical communication skills can be developed in various ways such as cooperative learning and group discussions. A 5 likert scale questionnaire was used to solicit qualitative data on the extent to which learners possessed mathematical communication skills and the role student teachers played to enhance these skills during teaching practice. Frequency distribution graphs were created using Question Pro to explore trends and patterns in the student teachers' responses. Participants were 60 mathematics student teachers in their fourth year who had finished their practicum. Results suggests that there is still room for improvement in learners' abilities to communicate mathematically. Mathematics educators who seek to encourage students' mathematical communication abilities through participating in innovative and creative learning activities should take this study into consideration. Cooperative learning, in which students are put into small groups where they can express their clear and logical ideas to the other students helps in enhancing the development of these mathematical communication skills.

Keywords: Communication; mathematical communication skills; teaching practice.

INTRODUCTION

The purposes of learning mathematics according to Hutopea, Saragih and Sakur (2019) are to enable students to (1) understand mathematical concepts; (2) use reasoning on patterns and traits, make mathematical manipulations in making generalizations, compile evidence, explain mathematical ideas and statements; (3) solve problems, including the ability to understand problems, design mathematical models, complete models and interpret solutions obtained; (4) communicate ideas with symbols, tables, diagrams, or other media; (5) have an attitude of appreciating the usefulness of mathematics in life; (6) have attitudes and behavior according to mathematical values and learning; (7) do motor activities using mathematical knowledge; and (8)

use simple teaching aids and technological results to carry out mathematical activities. Communication plays an important role in mathematics. Merriam-Webster (2004) defines communication as a process by which information is exchanged between individuals through a common system of symbols, signs, or behavior. NCTM (2000) states that communication is an essential part of mathematics and mathematics education. Without good communication, the development of mathematics will be hampered. Communication to be something major in teaching, assessing, and in learning mathematics (Tiffany, Surya, Panjaitan, & Syahputra, 2017). Kaya and Aydin (2016) opine that mathematical thinking skills and meaningful mathematical understanding are among the goals of current mathematics education. They further suggest that fostering mathematical communication in classroom settings is a strategy to develop students thinking skills by mathematical talk, discussion, and activities.

Mathematical representation, explanation, argument, and presentation are all related to mathematical communication. Students can express their opinions and ideas in various ways, including mathematical representations, written words, and other forms of writing (Tong, Uyen & Quoc, 2021). Mathematical communication skills is the ability of students to use mathematics as a tool of communication (language of mathematics), and the student's ability to communicate mathematics is learned as the content of the message should be delivered (NCTM, 2000). Mathematical Communication Skills (MCS) refer to the students' ability to (1) arrange and link their mathematical thinking through communication; (2) communicate their logical and clear mathematical thinking to their friends, teachers, and others; (3) analyze and assess mathematical thinking and strategies used by others; and (4) use mathematical language to express mathematical ideas correctly (Rohid, Suryaman, & Rusmawati, 2019). National Council of Teachers of Mathematics NCTM (2000) and Greenes and Schulman (1996) elaborate that the indicators of mathematical communication skills are (1) understanding mathematical ideas that are presented in the writing or oral, (2) revealing the mathematical ideas in writing or oral, (3) using mathematics language approach (notation, term and symbol) to represent mathematical information, (4) using representations mathematics (the formula, diagram, tables, graphs, model) to represent mathematical information. The following are also identified by Tong, Uyen & Quoc, (2021) as essential elements of mathematical communication skills. (1) recognizing and remembering necessary mathematical information presented in mathematical text or by others, reading comprehension, and taking notes on what was heard or written. (2) communicating mathematical contents, ideas, and solutions to others through oral or written expression (speaking or writing) (with appropriate completeness and accuracy). (3) effectively combining mathematical language (numbers, letters, symbols, charts, graphs, logical connections) with a common language or physical movements when presenting, solving similar problems, and evaluating math ideas in interactions (discussing, debating) with others is a requirement and (4) demonstrating self-assurance when presenting, expressing, asking questions, discussing, and debating mathematical concepts.

Mathematical communication may be perceived as a student's ability to convey something he knows through dialogue, events or interrelationships that occur in the classroom environment where there is transfer of the message (Rahmi, Nadia, Hasibah & Hidayat, 2017). Through

mathematical communication student teachers exchange and explain ideas or understanding to the learners, therefore developing their learners' communication skills. Kaya and Aydin (2016) argue that it is not adequate for students to learn and use only procedural and declarative knowledge but rather that they should acquire conceptual knowledge. Mathematical communication helps teachers to identify student misconceptions, either in the classwork, through homework, or through assessments, and reteach the material using their understanding of the developmental nature of what becomes before or after the misconception. Deep understanding of the content and the ability to communicate mathematically enables teachers to directly address the specific misunderstandings that students may have. These teachers have a deep understanding of concepts and utilize multiple ways to represent and explain them. They are also fluent with the procedures and practices their students will need in order to succeed in mathematics.

During teaching practice student teachers are required to communicate through oral, written and visual forms with the learners which clarifies and promotes understanding of concepts and can be a vehicle for both teachers and students to appreciate mathematics. Another term for interaction is communication or discourse. The use of discourse is very important that it fits into communication standard which calls for Instructional programs to enable all students to communicate their mathematical thinking coherently and clearly to peers, teachers, and others; to analyze and evaluate the mathematical thinking and strategies of others and to use the language of mathematics to express mathematical ideas precisely (Rohid, Aman & Rusmawati, 2019). For this dialogue to be effective learners need to possess mathematical communication skills such as: a) stating a situation, into drawings, diagrams, language, symbols, expressions or mathematical models; b) State image, diagrams, language, symbols, expressions or mathematical models in their own language; c) Listening, discussing, writing mathematics; d) Read a mathematical presentation with understanding; e) Revisit a mathematical description in its own language; and f) Compile questions about mathematics (Anggraeni, 2013).

Qohar (2011) argues that teachers need to help learners to develop mathematical communication skills in line with the new paradigm of learning mathematics. In the old paradigm, teachers are more dominant and only be transferring knowledge to students, while the students quietly and passively accept the transfer of knowledge from the teacher. But in the new paradigm of learning mathematics, teachers are leaders of community learning in the classroom, teachers guide students to actively communicate in the classroom. Teachers help students to understand mathematical ideas correctly and straighten out the students' understanding if one is not true. Student teachers should therefore be able to integrate communication with content instruction in their classrooms. They use mathematical instructional strategies that include classroom activities which: Have a high level of student engagement; demand higher-order thinking; follow an inquiry-based model of instruction – including a combination of cooperative learning, direct instruction, labs or hands-on investigations, and manipulatives; connect to students' prior knowledge to make meaningful real-world applications; integrate literacy activities into the courses – including content-based reading strategies and academic vocabulary development. The Learning Start with a Question (LSQ) model can be used as a learning model in efforts to

enhance the caliber of mathematics education and to enhance mathematical communication abilities. The LSQ model is a question-based, student-centered learning approach. The effectiveness of learning anything new will increase if the students participate and ask questions as opposed to passively taking the instructor's instructions. Making students ask questions about the material prior to receiving an explanation from the teacher is one technique to encourage active learning. By asking questions, which is the cornerstone to learning, this strategy can motivate pupils (Istarani, 2011). Particularly with the aid of learning modules, which make it simpler for pupils to comprehend concepts and resolve issues.The LSQ learning paradigm will increase students' desire to learn, encourage them to ask questions, and enhance their comprehension of the learning process.

METHODOLOGY

Research Design

The study employs a phenomenological approach to gain in-depth insight about student teachers' perceptions on the extent to which their learners possessed mathematical communication skills during teaching practice and the role they played to enhance these skills.

Sample

Purposive sampling was used to identify participants used in the study. A total of sixty (n=60) fourth-year level student teachers, studying for the Bachelor of Education in Senior Phase and Further Education and Training band (B.Ed SP&FET) in 2023 academic year, participated in this study. All the participants used in this study were fourth year students since they would have gone for teaching practice from their first year of study and their experiences would provide informed insight of what was happening during their teaching practice.

Data Collection

A closed structured questionnaire designed on a 5 likert scale of agreement with the variables ranging from Strongly Agree (1); Agree (2); Neutral (3); Disagree (4) and Agree (5) was used to collect data in this study. To realize the aim of the study, which is to gain in-depth insights about student teachers perceptions on learners mathematical communication skills, the following questions were asked:

1. Did your learners exhibit an understanding of mathematical ideas that are presented in writing or oral
2. Did your learners use mathematical language approach (notation, terms and symbols) to represent mathematical information?
3. Did your learners use representation in mathematics (formula, graphs, diagrams, tables, models) to represent information?
4. Did your learners communicate their logical and clear mathematical thinking to their peers and others?

Another aspect covered in the questionnaire regarded the role that student teachers played in enhancing learners' mathematical communication skills. For this student teachers had to respond to the following statements:

1. I used instructional/teaching strategies that had a high level of learner engagement during class.
2. I used instructional/teaching strategies that demanded higher order thinking.
3. I followed an inquiry-based model of instructional/teaching (e.g cooperative learning)
4. Which of these models were dominantly used in your class (cooperative learning, direct instruction,hands-on investigation?

Procedure

As already mentioned above, this study sought to gather data on the perceptions of student teachers on mathematical communication skills during teaching practice. Sixty participants were expected to complete a questionnaire posted on eThuto, ……. to determine the extent to which their learners possessed mathematical communication skills and the role they played to enhance these skills.

Ethical issues

Permission to conduct this study was sought from the Registrar of the CUT and was granted. All the names of participants used in this study were kept confidential. The researcher personally administered the questionnaire and collected it from the participants. The researcher explained the purpose of the study to all the participants before they completed the questionnaire. All participants were also assured that their responses would be kept confidential and that the data collected would only be used for purposes of this study. The student teachers were generally willing to give out their views on mentorship.

FINDINGS AND DISCUSSIONS

This section presents the major findings and discussion of data generated from the responses of mathematics student teachers regarding their perceptions on learners mathematical communication skills. These responses are based on the student teachers' experiences during teaching practice.

PONTE
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Figure 1. Did your learners exhibit an understanding of mathematical ideas that are presented in the writing or oral

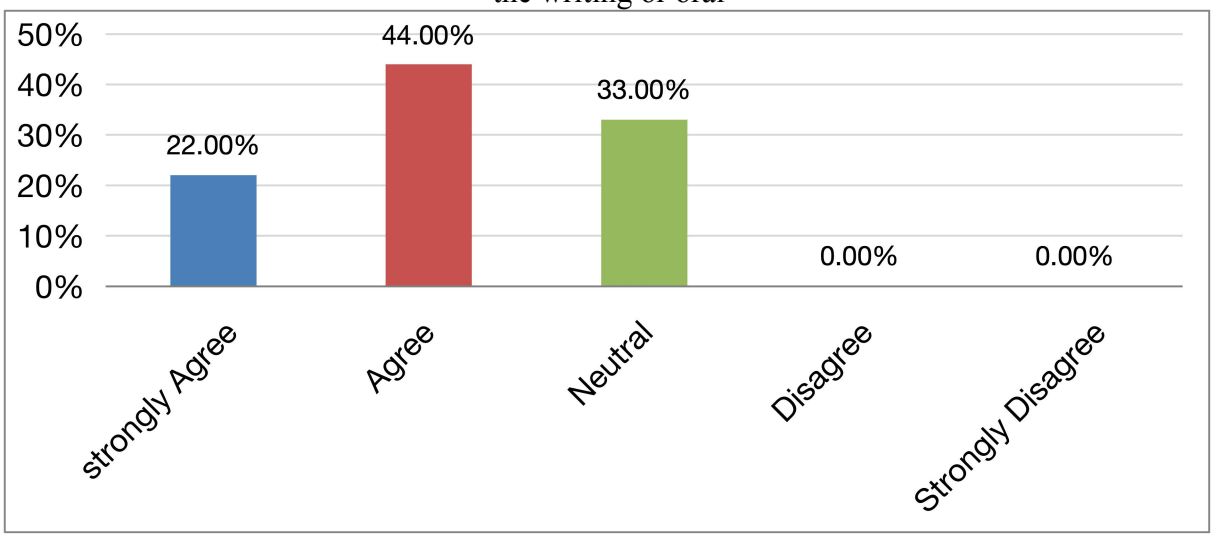

Figure 1 shows student teachers responses on whether their learners exhibited an understanding of mathematical ideas that were presented in writing or oral. Findings reveal that 22% 0f student teachers strongly agree that their learners exhibited an understanding of mathematical ideas presented in writing or oral and 44% agree. Findings further show that 33% of student teachers remained neutral. No student teacher disagreed with the statement. This finding therefore shows that student teachers succeed to empower learners to understand ideas that are presented in the writing or oral.

Figure 2. Did your learners use mathematical language approach (notation, term and symbol) to represent mathematical information?

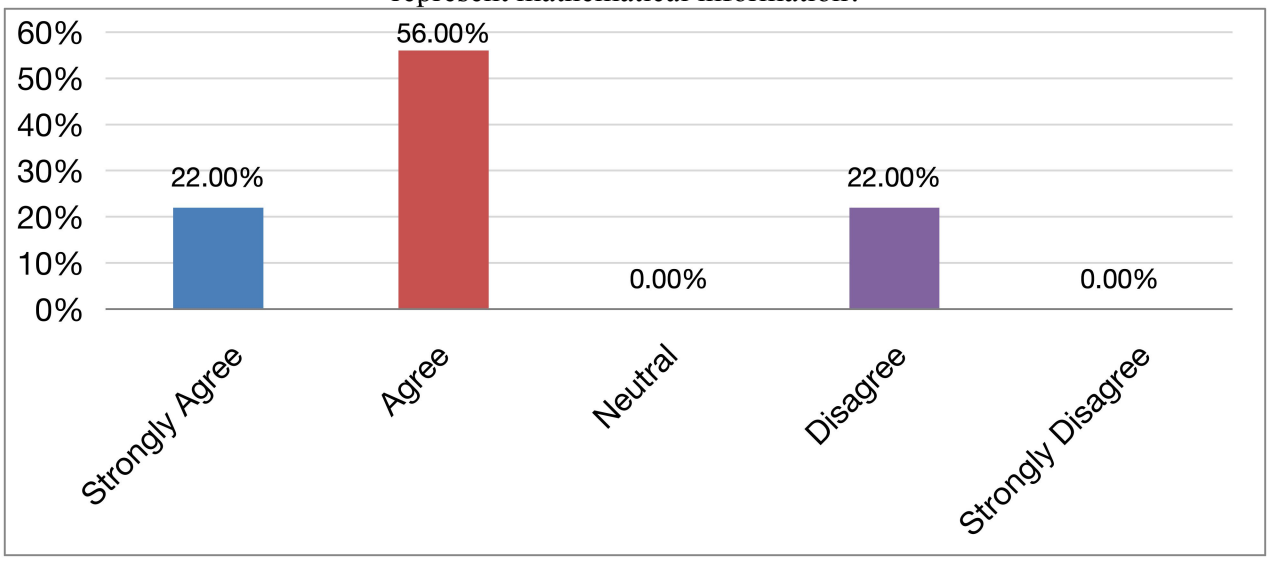

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Figure 2 represents student teachers responses on whether their learners used mathematical language approach (notation, term and symbol) to represent mathematical information. Findings reveal that majority of student teachers (78%) believe that learners used mathematical language approach (notation, term and symbol) to represent mathematical information. However 22% of student teachers observed that learners did not use mathematical approach (notation, term and symbol) to represent mathematical information. The use of notation, term and symbol is vital for the development of mathematical proficiency. The use and comprehension of symbols in mathematics learning helps learners to work with mathematical concepts in a theoretical manner.

Figure 3: Did your learners use representations in mathematics (the formula, graphs diagram, tables, models) to represent information

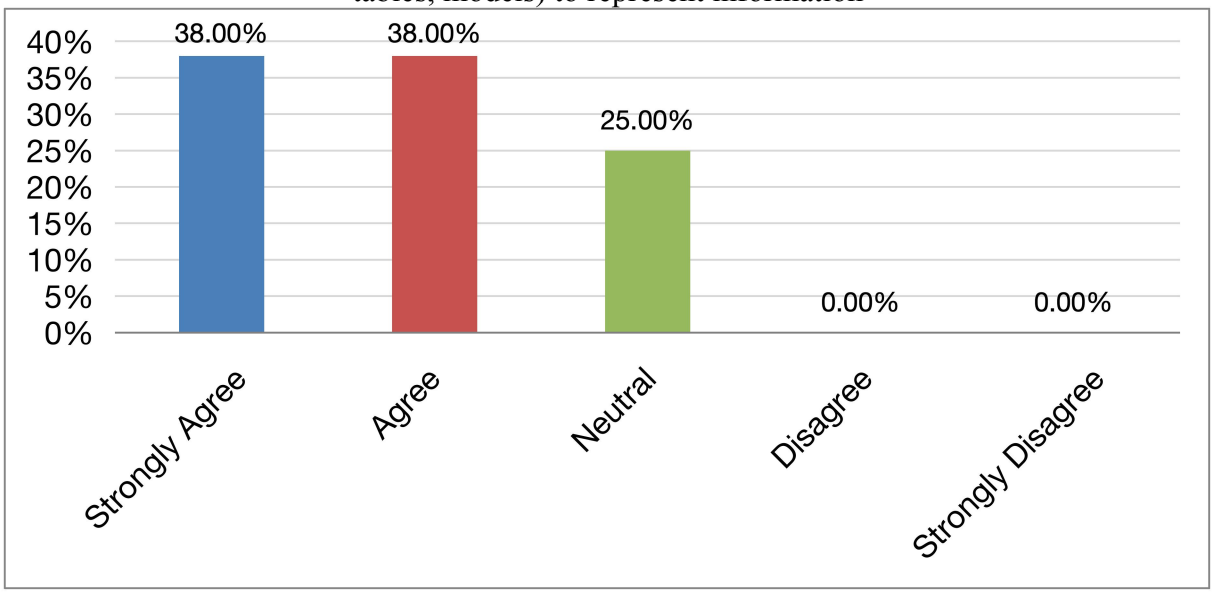

Figure 3 represents student teachers responses on whether their learners used representations in mathematics (formula, graphs,diagrams, tables, models) to represent information.Findings reveal that 38% of student teachers strongly agree and the same percentage agree that the learners used representations in mathematics while 25% remained neutral.. This implies that learners have the ability to translate the written words from their text and understand what the written words mean.In order to support students' understanding of mathematical concepts and relationships, communicate mathematical approaches, arguments, and understandings to oneself and to others, recognize connections among related mathematical concepts, and apply mathematical knowledge, representations should be treated as essential

PONTE
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Figure 4: Did your learners communicate their logical and clear mathematical thinking to their friends and others

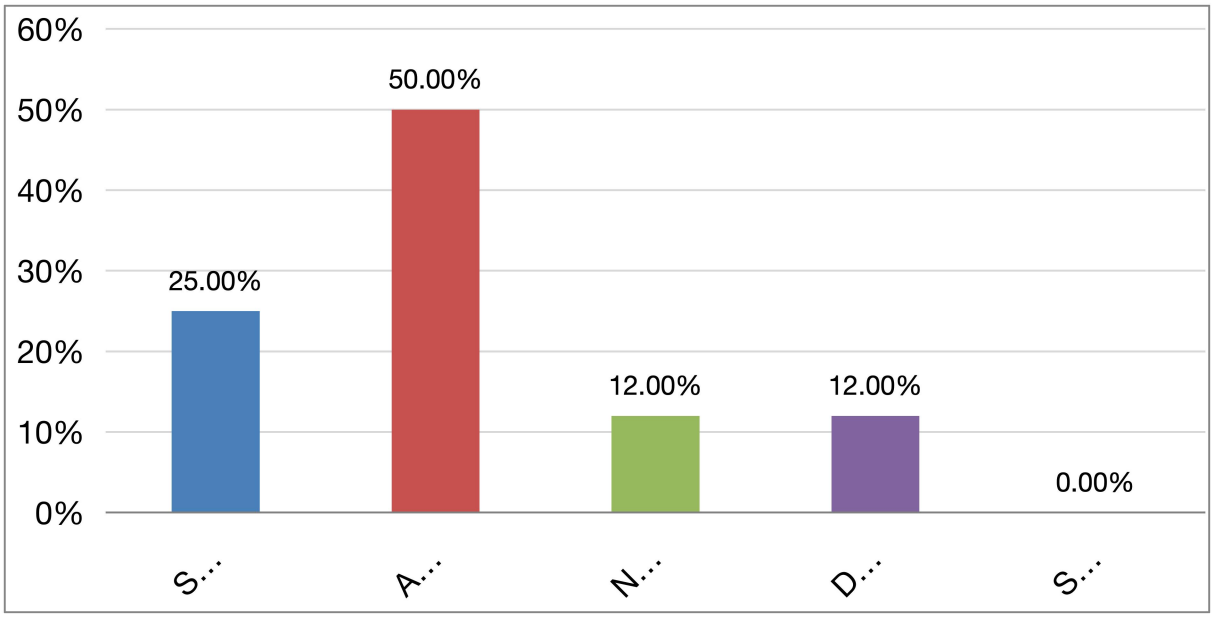

Figure 4 represents student teachers responses on whether their learners communicated their logical and clear mathematical thinking to their friends and others. Findings reveal the 50% of participants agreed and 25% strongly agreed that learners communicated their logical and clear mathematical thinking to their friends and others. However 12% of participants remained neutral while another 12% did not agree that learners communicated their logical and clear mathematical thinking to their friends and others. Small groups help the development of mathematical communication skills, according to Brenner (1998). Due to the small groups, each student will voice their thoughts more passionately. Students will have a fantastic opportunity to practice their mathematics communication abilities thanks to this.

PONTE
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Figure 5: Did you follow an inquiry-based instructional model in your classes

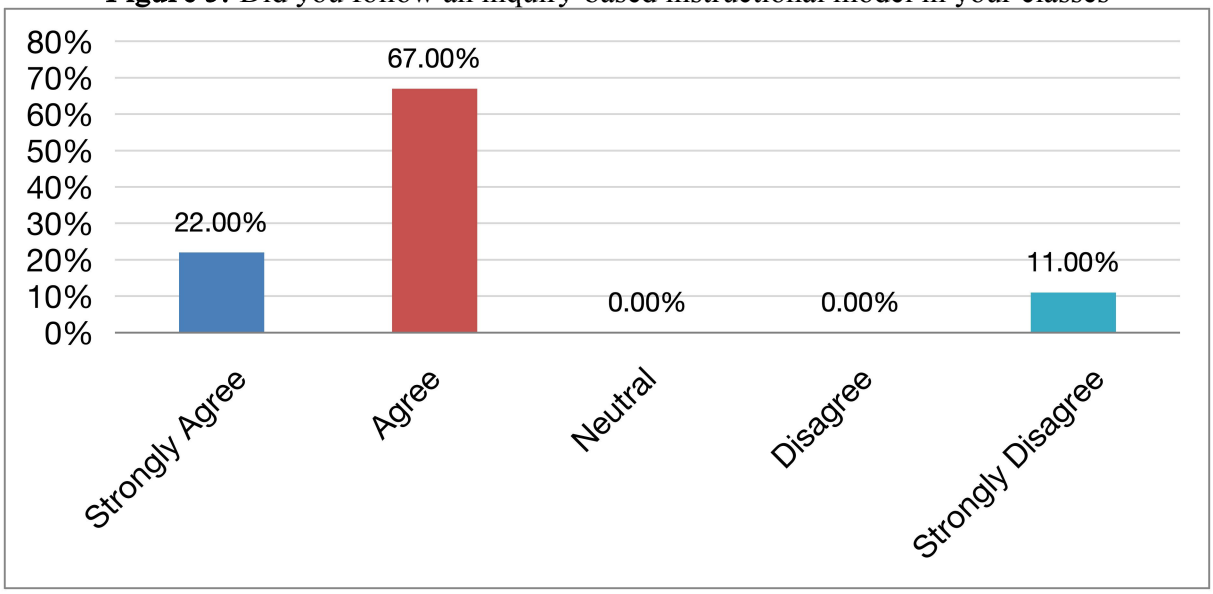

Figure 5 represents student teachers responses on whether they followed an inquiry-based instructional model. Findings reveal that 67% of participants agreed and 22% strongly agreed that they used inquiry-based instructional model in their classrooms to teach mathematics. A teaching strategy that puts students at the center of instruction is inquiry-based learning, which encourages students to research and ponder real-world issues. Students are actively involved in the learning process and given the chance to explore their inborn interests in this type of learning environment. Students can integrate what they are learning in the classroom with the outside world through this style of learning, which frequently involves hands-on activities. It has been demonstrated that inquiry-based learning enhances students' mathematical communication skills hence their critical thinking, problem-solving, and creative abilities.

CONCLUSION

From this study it can be concluded that during teaching practice student teachers succeed to empower learners to understand ideas that are presented in the writing or oral. The use of notation, term and symbol is vital for the development of mathematical proficiency and the use and comprehension of symbols in mathematics learning helps learners to work with mathematical concepts in a theoretical manner. This still needs to be emphasized by student teachers during teaching practice. To encourage proper development of mathematical communication skills student teachers need to make use of cooperative learning, where students are divided into small groups that afford them to communicate their logical and clear thinking to the other learners in the group.

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