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Investigation of Math Beliefs, Self-Efficacy and Prospective Math Teachers' Conceptions

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Abstract: This research used the case study method to investigate the mathematics teaching and learning conceptions of prospective mathematics teachers with a focus on three key aspects, namely "Mathematical Beliefs" (Belief in Mathematics) "Mathematics Self-Efficacy" (Self-Confidence in Mathematics), and "Self-Efficacy in Teaching Mathematics" (Self-Confidence in Teaching Mathematics). The research method used is a qualitative approach using interviews as a data collection tool. Data collected from interviews was analyzed using thematic analysis. This analysis involved identifying thematic patterns in the data that reflect the research participants' conceptions of teaching and learning mathematics. This research focused on understanding the participants' frames of mind and identifying factors that influence their views and beliefs related to mathematics and teaching mathematics. The results of the research show that there is a complex relationship between these three factors. First, "Mathematical Positive beliefs", where mathematics is considered relevant in everyday life, influence the development of Mathematics Self-Efficacy. "Prospective mathematics teachers who see mathematics as a useful tool tend to have higher self-confidence in understanding mathematics. Second, "Mathematics Self-Efficacy" has a significant impact on "Self-Efficacy of Teaching Mathematics." Prospective mathematics teachers who feel confident in their mathematics abilities also feel more confident in teaching mathematics concepts to students.

Keywords: Conceptions of Teaching and Learning Mathematics, Mathematical Beliefs, Mathematics Self-Efficacy, Self-Efficacy of Teaching Mathematics.

1 Introduction

Education is an important aspect in the development of society and civilization [18;21]. One of the subjects that is the backbone of education is mathematics. Mathematics is not only an integral part of the educational curriculum, but also plays a key role in the development of critical thinking, analytical and problem solving skills [6]. Therefore, the role of mathematics teachers in the learning process is very vital. Prospective mathematics teachers must have a deep understanding of the conception of mathematics teaching and learning, as well as have confidence (self-efficacy) in mathematics and the ability to teach mathematics.

In the context of mathematics learning, there are several factors that influence prospective teachers' conceptions of teaching and learning mathematics. The three main factors that will be discussed in this study are "Mathematical Beliefs" (Belief in Mathematics) "Mathematics Self-Efficacy" (Self-Confidence in Mathematics), and "Self-Efficacy Teaching Mathematics" (Self-Confidence in Teaching Mathematics). These three factors are interrelated and influence how a prospective mathematics teacher designs and manages the mathematics learning process in the classroom.

Belief in mathematics includes prospective teachers' views of the nature of mathematics as a scientific discipline, its relevance in everyday life, and their beliefs about their ability to understand and teach mathematics. Believing in positive mathematics will encourage prospective teachers to motivate students, create a positive learning environment, and integrate mathematical content with the real world [5]. Conversely, believing in negative mathematics can hinder prospective teachers' ability to inspire students and convey mathematical concepts effectively.

Mathematics Self-efficacy refers to prospective teachers' beliefs in their ability to succeed in understanding, solving problems, and applying mathematical concepts [8]. Prospective teachers who have mathematics High self-efficacy tend to be more confident in facing mathematical challenges, and this will be reflected in the way they teach and support students in overcoming mathematical difficulties.

Self-efficacy reflects prospective teachers' beliefs in their ability to design and manage an effective mathematics learning process [9]. This involves the teacher candidate's ability to explain mathematical concepts clearly, motivate

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students, assess their progress, and adapt teaching methods to suit individual needs. Self-confidence in teaching mathematics will influence their approach to teaching, including the choice of teaching strategies and interactions with students [10].

In this study, the author will explore the relationship between these three factors in the context of the conception of mathematics teaching and learning by prospective mathematics teachers. This research will help understand how to improve the quality of mathematics education by strengthening prospective teachers' confidence in mathematics and mathematics teaching. In addition, this research can also provide a better view of how prospective mathematics teachers can be empowered to become more effective teachers in inspiring and guiding future generations in understanding and appreciating mathematics.

2 Theoretical Basis

Conceptions of Teaching and Learning Mathematics

The Concept of Teaching and Learning Mathematics is a concept that includes understanding and views about how mathematics should be taught and studied [3]. This conception is a mental framework possessed by mathematics educators, both mathematics teachers and prospective mathematics teachers. This conception covers various aspects, including views about the goals of teaching mathematics, selection of teaching methods, evaluation, and beliefs about mathematics itself [17]. These conceptions can greatly influence teaching approaches and practices in mathematics classrooms.

In the educational context, the Concept of Teaching and Learning Mathematics is key in shaping students' learning experiences. If a teacher has a strong conception of mathematics as a relevant and useful tool in everyday life, they are likely to choose teaching approaches that emphasize the application of mathematics in real-world contexts. In contrast, if their conception of mathematics is more theoretical or limited to understanding mathematics as a series of formulas and rules, their teaching approach may be more theoretical and less related to practical application.

Apart from that, the Concept of Teaching and Learning Mathematics also plays a role in shaping teachers' expectations and beliefs regarding students' abilities [14]. Teachers who have a positive conception of students' abilities in mathematics tend to have higher expectations for student achievement. Conversely, teachers with less optimistic conceptions may not provide enough support for students to reach their full potential in mathematics.

This conception can develop and change with teacher experience, training, and reflection. Therefore, research on Conceptions of Teaching and Learning Mathematics can provide valuable insights into the professional development of mathematics teachers. Additionally, a better understanding of these conceptions can help improve the quality of mathematics teaching and help students to develop a deeper understanding of this subject, which is a key skill for their future.

Mathematical Beliefs

Mathematical Beliefs (Belief in Mathematics) refer to an individual's beliefs, attitudes and views towards the subject of mathematics [4]. This includes how a person views mathematics as a scientific discipline, the extent to which they feel capable of understanding and succeeding in mathematics, as well as whether they consider mathematics to be a relevant skill in everyday life [19].

Belief in Mathematics can vary greatly from individual to individual. Some people may have a positive view of mathematics, seeing it as a useful tool for solving problems in a variety of contexts. They may feel confident in their abilities in mathematics and see it as a necessary skill in many aspects of life.

On the other hand, some individuals may have a negative view of mathematics and feel insecure in dealing with it [2]. They may consider mathematics a difficult subject or irrelevant to their lives. These kinds of beliefs may influence their motivation to learn mathematics and their performance in this subject.

The Importance of Mathematics Beliefs in an educational context is that these beliefs can influence an individual's approach and efforts in understanding and dealing with mathematics [20]. Teachers, for example, who have a positive view of mathematics tend to be more enthusiastic about teaching this subject and can create a positive learning environment. On the other hand, if a student has negative beliefs about mathematics, they may need additional support to overcome these barriers and build their confidence in the subject.

Mathematics Self-Efficacy

Mathematics Self-Efficacy (Self-Confidence in Mathematics) refers to a person's level of confidence or self-confidence in their ability to understand, master, and succeed in mathematics subjects [11]. It includes individuals' beliefs about the

extent to which they are able to complete mathematical tasks, overcome barriers in understanding mathematical concepts, and achieve academic goals in this subject.

Mathematics Self-Efficacy is a very important concept in the context of mathematics education [16]. Individuals who have mathematics High self-efficacy tend to be more motivated to learn mathematics and may be more courageous in facing challenges in learning [13]. They believe they can succeed in mathematics, even in difficult situations.

On the other hand, individuals with mathematics Low self-efficacy tend to feel hopeless or reluctant to face difficult mathematics material [12]. They may be more likely to avoid tasks involving mathematics or have a negative perception of their abilities in this subject.

Mathematics Self-Efficacy can be influenced by various factors, including previous experience in mathematics, support from parents and teachers, and experience in overcoming mathematical challenges [1]. Mathematical development Positive self-efficacy can be an important focus in mathematics education, and teachers have a significant role in helping students develop their self-confidence in this subject.

The Importance of Mathematics Self-Efficacy is that strong self-confidence in mathematics can influence a person's learning outcomes and academic achievement in this subject. Therefore, in mathematics education, it is important to pay attention to and support the development of mathematics self-efficacy in students and prospective mathematics teachers, so that they can feel more confident in dealing with mathematics material and reach their full potential in this subject.

Self Efficacy of Teaching Mathematics

Self-Efficacy is the level of self-confidence of individuals, especially mathematics teachers or prospective teachers, in their ability to teach and deliver mathematics subject matter effectively to students [7]. This includes an individual's beliefs about his or her ability to explain mathematical concepts clearly, organize learning, and create a supportive learning environment.

Self-Efficacy in Teaching Mathematics is very important in the world of education, especially in the context of teaching mathematics. Mathematics teachers who have high mathematics teaching self-efficacy tend to be more motivated to develop their teaching skills [15]. They feel confident that they can overcome the challenges of teaching mathematics and achieve positive outcomes in student learning. Conversely, teachers who have low self-efficacy for teaching mathematics may not feel confident in teaching this subject. They may find it difficult to explain mathematical concepts clearly or feel overwhelmed by various aspects of mathematics teaching.

Developing Mathematics Teaching Self-Efficacy is an important focus in the training and development of mathematics teachers. Teachers who feel confident in their ability to teach mathematics tend to create more positive learning experiences for students. They may be more willing to try different teaching methods and interact actively with students, which can improve the quality of mathematics learning.

The importance of mathematics teaching self-efficacy is that it can influence students' learning experiences and their academic outcomes in this subject. Therefore, in the context of mathematics education, supporting the development of mathematics teaching self-efficacy in teachers is an important step in improving the effectiveness of mathematics teaching and helping students achieve a better understanding of this subject.

3 Research Methodology

Research Design

This research used a qualitative approach with the interview method as the main data collection technique [22]. This approach was chosen to enable the authors to gain a deeper understanding of the participants' views and experiences related to " Mathematics Beliefs " (Belief in Mathematics) " Mathematics Self-Efficacy " (Self-Confidence in Mathematics), and " Self-Efficacy in Teaching Mathematics" (Self-Confidence in Teaching Mathematics).

Subsections Participants

Research participants in this study will consist of prospective mathematics teachers who are currently participating in teacher education programs at several higher education institutions. The selection of participants will be carried out through a sampling process aimed at understanding in depth their experiences, views and beliefs related to the conception of teaching and learning mathematics.

Research Instruments

The main instrument that will be used in this research is an interview guide designed to explore participants' views regarding mathematics, their self-confidence in mathematics, and their self-confidence in teaching mathematics. This

instrument will include open-ended questions that allow participants to explain their thinking in more depth.

Research Procedures

The research procedure will begin with the identification of participants who are willing to participate in interviews. Approved participants will be invited for an individual interview session. In this interview, participants will be asked to talk freely about their views on mathematics, their confidence in understanding and teaching mathematics, as well as their experiences in the mathematics learning process.

During the interview, the researcher will record transcription notes that are detailed and reflect the participant's statements. Interviews will be guided by a pre-prepared interview guide, but will also provide flexibility for participants to express their thoughts and experiences in greater depth.

Technique of Data Analysis

Data collected from interviews will be analyzed using thematic analysis. This analysis will involve identifying thematic patterns in the data that reflect the research participants' conceptions of teaching and learning mathematics. This research will focus on understanding the participants' frames of mind and identifying factors that influence their views and beliefs related to mathematics and teaching mathematics.

The results of the analysis will be used to provide in-depth insight into how the conception of mathematics teaching and learning develops in prospective mathematics teachers. These findings will provide a valuable contribution to understanding the psychological and social aspects of mathematics education.

4 Results

In the research findings that have been described, it can be seen that "Mathematical Beliefs" (Belief in Mathematics) "Mathematics Self-Efficacy" (Self-Confidence in Mathematics), and "Self-Efficacy in Teaching Mathematics" (Self-Confidence in Teaching Mathematics) are not only separate entities, but also have a complex relationship.

Table 1: Interview Data Extract

Participant 1 (<i>Self High Efficacy</i>)	I have always felt confident in my mathematical abilities. This helps me feel more confident in teaching. I feel that if I know math well, I can more effectively explain the concepts to students
Participant 2 (<i>Self Low Efficacy</i>)	To be honest, I still feel unsure about my math skills. It makes me worry that I won't be able to explain concepts well to students. I need to study more and increase my confidence in mathematics
Participant 3 (Self-Efficacy of Teaching Higher Mathematics)	"I am confident that I can teach mathematics well. This makes me braver to try various teaching methods and interact more actively with students. I feel I have control over the learning process."
Participant 4 (Low Mathematics Teaching Self-Efficacy)	" My lack of confidence in teaching mathematics made me somewhat limited in my teaching approach. I felt not competent enough and felt worried if students asked difficult questions. I need to be more confident in teaching."

Interview participants who have "Mathematical Beliefs" positive tend to have "Mathematics Higher Self-Efficacy". This can be explained by the assumption that believing in mathematics as a discipline that is relevant and useful in everyday life can increase a person's self-confidence in understanding and overcoming challenges in mathematics. In contrast, participants who have a negative view of mathematics may tend to have mathematics lower self-efficacy because they may feel more uncertain about their abilities in mathematics.

In the interview data, participants with "Mathematics High Self-Efficacy" tends to have higher "Mathematics Teaching Self-Efficacy". This may be caused by strong self-confidence in understanding mathematics, which makes them feel more capable of explaining mathematical concepts to students and managing the learning process. mathematics effectively.

Participants who have high "Mathematics Teaching Self-Efficacy" tend to be more willing to try various teaching methods and interact actively with students. They feel they have control over the mathematics learning process. A Mathematics teacher who has "Mathematics High Self-Efficacy" tends to be a more confident teacher and may be more effective at inspiring students. Therefore, the development of mathematics Self-efficacy should be a focus in teacher training and their professional development.

The findings of this research indicate that these concepts are interrelated in forming the conception of mathematics teaching and learning by prospective mathematics teachers. Improving "Mathematical Beliefs," "Mathematics Self-

Efficacy," and "Self-Efficacy of Teaching Mathematics" have a positive impact on teaching approaches, student motivation, and the overall quality of mathematics learning. Therefore, mathematics teacher education needs to pay attention to the development of self-confidence in all these aspects to improve teaching effectiveness mathematics.

5 Discussion

In the results of this research, it appears that there is a significant relationship between three main factors in the conception of mathematics teaching and learning by prospective mathematics teachers: "Mathematical Beliefs" (Belief in Mathematics) "Mathematics Self-Efficacy" (Self-Confidence in Mathematics), and "Self-Efficacy in Teaching Mathematics" (Self-Confidence in Teaching Mathematics).

First, the role of "Mathematical Beliefs" in forming conceptions of teaching and learning mathematics is very important. Interview participants who have a positive view of mathematics tend to see it as a powerful tool for solving problems in everyday life. This creates an important foundation for the development of "Mathematics Self-Efficacy." Self-confidence in mathematics tends to develop better if someone feels that mathematics is useful and relevant in their daily lives. In other words, believing in mathematics becomes a strong foundation for self-confidence in understanding and dealing with mathematics.

Second, "Mathematics Self-Efficacy" also had a large impact on "Self-Efficacy of Teaching Mathematics." Participants who felt confident in their understanding of mathematics were more likely to feel confident in their ability to explain mathematical concepts to students and manage the mathematics learning process in the classroom. Self-confidence in mathematics creates the basis for self-confidence in teaching mathematics.

These findings highlight the importance of developing mathematics self-efficacy as the first step in forming strong mathematics teaching self-efficacy. Mathematics teachers who feel confident in their understanding of mathematics are more likely to be more confident teachers, which in turn can influence student motivation and the overall quality of mathematics learning.

In the overall context of mathematics education, these findings have significant implications. Mathematics teachers should be provided with support and training that enables them to develop self-confidence in mathematics and self-confidence in teaching mathematics. Mathematics teacher education must encourage a positive view of mathematics and show its relevance in everyday life, so that it can help prospective mathematics teachers in forming an effective conception of mathematics teaching and learning. Thus, developing this entire spectrum of self-confidence will have a positive impact on the quality of mathematics teaching and student learning outcomes.

6 Conclusions

In conclusion, this study reveals the complex interrelationship between "Mathematical Beliefs" (Belief in Mathematics) "Mathematics Self-Efficacy" (Self-Confidence in Mathematics), and "Self-Efficacy in Teaching Mathematics" (Self-Confidence in Teaching Mathematics) in the conception of mathematics teaching and learning by prospective mathematics teachers.

First, "Mathematical Positive beliefs", where mathematics is considered relevant and useful in everyday life, can provide a strong foundation for the development of Mathematics Self-Efficacy." Self-confidence in mathematics tends to grow better if individuals see mathematics as a powerful tool in solving problems.

Second, "Mathematics Self-Efficacy" plays a key role in shaping "Mathematics Teaching Self-Efficacy." Mathematics teachers who feel confident in their understanding of mathematics are more likely to be teachers who are confident in explaining mathematical concepts to students and managing mathematics learning effectively.

These findings indicate that mathematics teacher education needs to pay attention to and support the development of self-confidence in mathematics self-efficacy, and self-efficacy for teaching mathematics. Mathematics teachers who are confident in all of these aspects will be more effective in teaching and can motivate students to develop a deeper understanding of mathematics.

Thus, improving the quality of mathematics teaching and student learning outcomes can be achieved through efforts to develop holistic self-confidence in prospective mathematics teachers. In addition, recognizing and understanding the relationship between these three factors can help mathematics educators in designing more effective and relevant training programs in supporting the development of competent and confident mathematics teachers.

Conflict of interest

The authors declare that there is no conflict regarding the publication of this paper.

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