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# Mathematics student teachers' external supervisors' beliefs about mathematics: ODeL environment in focus

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**Abstract**

**Background:** There are diverse beliefs regarding the nature of mathematics, which directly influence the teaching and learning approaches adopted in mathematics education. These beliefs range from mathematics being a collection of facts, rules, and skills, to viewing it as a dynamic and ever-evolving discipline.
**Aim:** This study investigates the beliefs of mathematics student teachers' external supervisors regarding the nature of mathematics, learning mathematics, mathematics achievement, and their preparedness for teaching mathematics within an Open Distance e-Learning (ODeL) environment to address challenges and improve the effectiveness of Teaching Practice (TP) supervision.
**Method:** A quantitative survey design was employed, utilizing a structured questionnaire adapted from the Firstmath Project. Data were collected from 43 respondents out of a population of 76 mathematics student teachers' external supervisors, selected through random sampling across six provinces in South Africa. The analysis framework was guided by Ernest's, three conceptions of mathematics: problem-solving, Platonist, and Instrumental views. Descriptive statistics were used to analyze the data.
**Results:** The findings revealed a significant gap in external supervisors' understanding of the mathematics classroom as a dynamic environment for teaching and learning. Many supervisors lacked exposure to contemporary pedagogical strategies tailored for the ODeL context.
**Conclusion:** The study recommends the implementation of developmental programs aimed at equipping mathematics external supervisors with innovative approaches to teaching and learning mathematics. Such initiatives would enhance their readiness to support student teachers effectively in an ODeL environment.

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## INTRODUCTION

Teaching Practice (TP) is widely recognized as a critical component of teacher education programs, bridging theoretical learning with practical application in authentic school environments. In South Africa, the National Policy Framework for Teacher Education and Development was first established in 2007. This policy was later updated in 2015 through the Minimum Requirements for Teacher Education Qualifications (MRTEQ), highlighting the significance of structured, supervised, and evaluated workplace-based learning experiences. At the University of South Africa (UNISA)—the largest Open Distance e-Learning (ODeL) institution on the African continent—Teaching Practice is implemented through the placement of student teachers in schools of their choice, where they are supervised by external supervisors. However, the ODeL context presents unique challenges, including limited direct interaction between supervisors and student teachers and the frequent allocation of non-specialist supervisors to oversee subject-specific teaching (Jojo, 2022; Naphiyo & Kamwamba, 2024). These challenges highlight the critical need for a structured and contextually relevant supervision framework to ensure that TP contributes meaningfully to the preparation of competent and confident teachers capable of addressing 21st-century educational demands.

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However, despite the structured framework outlined in policies such as MRTEQ, several challenges hinder the effective implementation of Teaching Practice (TP), particularly in the Open Distance e-Learning (ODeL) context at the University of South Africa (UNISA). One significant challenge is the shortage of academic staff to supervise the large number of student teachers annually (Johnson et al., 2019). This often leads to the allocation of supervisors without subject specialization, such as non-mathematics supervisors overseeing mathematics teaching practice, which limits the quality of subject-specific feedback and guidance. Studies by Kourioeos Jin et al. (2021) and Tian & Guo (2023) highlight similar concerns, where student teachers expressed dissatisfaction with supervisors' limited knowledge of subject content and their inability to provide constructive, dialogical feedback. Furthermore, the ODeL environment presents additional challenges, including limited direct interaction between supervisors and student teachers and a lack of opportunities for real-time observation and mentoring (Gumbo & Gasa, 2023; Lehong et al., 2019). This often results in superficial evaluations that focus on general pedagogy without addressing the conceptual understanding and implementation of subject-specific content, as noted by (Desai, 2012). These challenges underscore the critical need for improving supervision practices to align with the unique demands of ODeL and ensure that TP effectively supports the development of student teachers' pedagogical and content knowledge.

Although various studies have highlighted the importance of external supervisors' trust in teaching and learning, most of these studies have focused on conventional educational contexts. For instance, previous research (OECD, 2009; Pelikan et al., 2021; Shahali & Halim, 2024; Texas State University & Gordon, 2023; Vela & Pelayo, 2022) has shown that supervisor trust significantly influences the effectiveness of teacher candidate supervision, particularly in providing constructive feedback. However, these findings have not addressed the unique challenges posed by Open Distance e-Learning (ODeL), such as limited direct interaction and the lack of in-depth understanding of the subject matter being supervised. Additionally, while specialized training has been shown to improve supervision quality (Nührenbörger et al., 2024; Van Eycken et al., 2024; Yang et al., 2024), there remains a gap in understanding how external supervisors' trust in mathematics specifically impacts supervision processes within ODeL environments. This study aims to explore the beliefs of mathematics student teachers' external supervisors about the nature of mathematics, the learning of mathematics, mathematics achievement, and their preparedness to supervise mathematics instruction in an Open Distance e-Learning (ODeL) environment. By addressing these beliefs, the research seeks to understand how external supervisors navigate the challenges of ODeL, including limited direct interaction and non-specialist supervision, and provide actionable insights to enhance the effectiveness of Teaching Practice (TP) supervision. To operationalize this aim, the study is guided by the following research questions::

1. To what extent do mathematics student teachers' external supervisors agree or disagree with each belief about the nature of mathematics?
2. To what extent do mathematics student teachers' external supervisors agree or disagree with each belief about learning mathematics?
3. To what extent, if at all, are mathematics student teachers' external supervisors prepared for their teaching careers?

## THEORETICAL FRAMEWORK

### Instrumentalist, Platonist, and Problem-Solving Perspectives in Mathematics Education

Beliefs about mathematics play a critical role in shaping how mathematics is taught and learned. Teaching reforms often face significant barriers unless there is a fundamental shift in teachers' deeply ingrained beliefs about the nature of mathematics and its instructional methods.

According to Marshman & Goos (2018), teachers' understanding of the essence of mathematics encompasses their entire belief system about its fundamental characteristics. These beliefs, whether explicitly articulated or implicitly held, influence instructional practices and decision-making processes. While some teachers may lack a fully developed philosophical perspective, their implicit beliefs significantly affect their teaching approaches and interactions with students.

Beliefs in mathematics are understood as propositions or understandings that individuals perceive as truths, even in the absence of empirical evidence, significantly shaping how individuals approach learning and teaching mathematics. Smith (2014) defines beliefs as propositions that individuals accept as truths, while Kalchman (2011) describes them as aspects that influence actions and preferences. These beliefs, as Ngoako (2018) highlights, drive educators' teaching preferences, guiding their choices in content and methods. In mathematics education, beliefs serve as a foundational component influencing both cognitive and affective processes, as noted by McLeod & McLeod (2002), who emphasize that beliefs impact how individuals perceive mathematical concepts and their abilities. Positive beliefs, according to Beswick (2008), can enhance classroom practices, fostering effective teaching, whereas negative beliefs may hinder educational outcomes. Similarly, Irez (2007) notes that beliefs play a critical role in shaping teachers' instructional planning, decision-making, and classroom behavior. Practical implications of these beliefs are evident in the findings of Peker & Ulu (2018), who link pre-service teachers' beliefs to their levels of teaching anxiety, and Álvarez et al. (2021), who connect beliefs to cognitive flexibility and creativity, both essential for effective mathematical reasoning. Summarizing these perspectives, Ernest (1989) identified three distinct perspectives that underpin teachers' beliefs about mathematics: the Instrumentalist, Platonist, and Problem-Solving views. These perspectives provide a framework for understanding the philosophical foundations of teachers' instructional practices. The following framework (Figure 1) visually represents these perspectives and their core attributes.

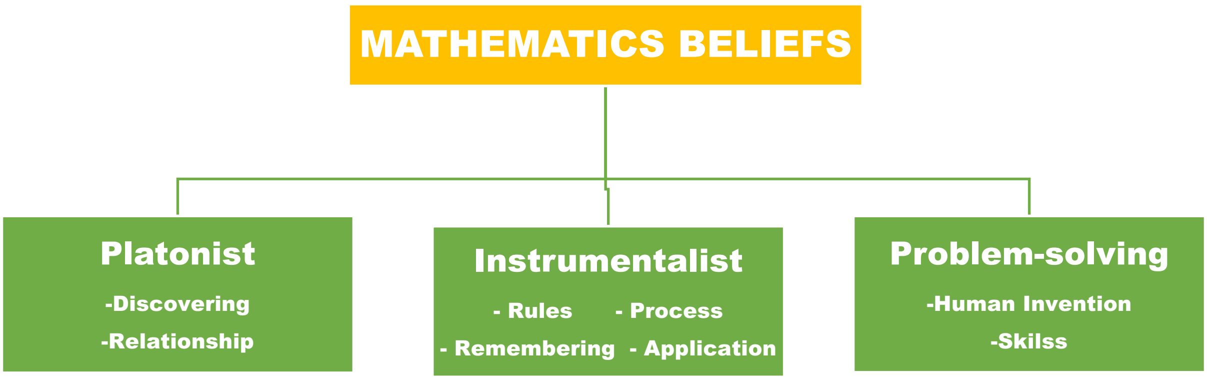


**Figure 1.** Mathematics Beliefs Framework (Adapted from Ernest, 1989).

### 1. The Instrumentalist Perspective

From this view, mathematics is seen as a collection of rules, facts, and procedures that serve external goals. Teachers adopting this perspective focus on helping students master these rules through rote learning and repetition. Skemp (2012) describes this approach as emphasizing memorization and accuracy, often disconnected from relational understanding. For instance, Mahmudi (2021) found that many Grade 10 learners viewed mathematics instrumentally, applying formulas without understanding their derivation, such as knowing that the area of a rectangle is "length × width" but failing to comprehend why this formula works. This perspective limits students' ability to develop deeper mathematical reasoning.

2. **The Platonist Perspective**

The Platonist view perceives mathematics as a coherent and immutable body of knowledge characterized by logical structure and permanence. Teachers adopting this view aim to develop students' conceptual understanding by highlighting the relationships between mathematical concepts. While this perspective acknowledges the dynamic nature of mathematics, it emphasizes its structured foundation. According to Ernest (1989), this approach allows students to explore mathematical principles, fostering creativity while maintaining logical coherence.

3. **The Problem-Solving Perspective**

This perspective considers mathematics as a dynamic and evolving field of human inquiry embedded in social and cultural contexts. Teachers with this view emphasize developing students' problem-solving skills, encouraging creativity and exploration. Mathematics is understood as an ongoing process of inquiry, rather than a fixed body of knowledge (Ernest, 1989). This perspective encourages learners to engage deeply with mathematical concepts, focusing on both "what" and "why" in solving problems.

These three perspectives can be viewed hierarchically, from the Instrumentalist focus on procedural knowledge to the Platonist emphasis on structured understanding, and finally to the Problem-Solving view of mathematics as dynamic and exploratory. Ernest's (1989) framework underscores how these beliefs influence not only classroom practices but also teachers' broader decision-making processes.

### Relevance to Supervision in Open Distance e-Learning (ODeL)

Teachers' beliefs about mathematics have profound implications for their instructional practices and their ability to guide students. In the context of Open Distance e-Learning (ODeL), where supervision often involves limited direct interaction and diverse challenges, these beliefs play a critical role. Supervisors with a predominantly instrumentalist view may focus on procedural accuracy, while those with a problem-solving perspective may emphasize fostering deeper mathematical understanding. Understanding these perspectives provides a valuable lens for evaluating supervisors' beliefs and their impact on the effectiveness of Teaching Practice (TP) in distance education.

This study adopts Ernest's (1989) framework to examine the beliefs of mathematics student teachers' external supervisors and their influence on supervision practices in ODeL. By analyzing these perspectives, the research seeks to provide insights into optimizing supervision to better support mathematics teaching and learning in distance education settings.

## METHOD

### Research Design

This study employed a quantitative research design using a survey method to explore external supervisors' beliefs about mathematics. The survey design was chosen due to its efficiency in collecting large amounts of data from a distributed population across multiple provinces. The structured questionnaire provided standardized responses, allowing for the consistent measurement and analysis of beliefs. This design was particularly suited to understanding the complex dimensions of mathematics beliefs, which include perspectives on the nature of mathematics, teaching practices, and learning processes. By employing a quantitative approach, the study aimed to provide a clear and objective description of the patterns and trends within the participants' responses.

**Participants**

The participants of this study were external supervisors of mathematics student teachers, selected from six randomly chosen provinces in South Africa. These supervisors play a critical role in overseeing and mentoring student teachers during their teaching practice. The population of the study comprised 76 external supervisors, and a random sampling technique was employed to select 43 respondents to ensure representativeness and reduce selection bias. This sampling approach also aimed to capture diverse perspectives on mathematics beliefs across different geographical and institutional contexts. The selected supervisors were experienced professionals who were actively involved in supporting mathematics student teachers in an Open Distance e-Learning (ODeL) environment, making their beliefs particularly relevant to the study.

**Instrument**

The primary instrument for data collection was a structured questionnaire, adapted from the Firstmath Project, a recognized framework for studying beliefs about mathematics. The questionnaire consisted of 20 items, designed to capture responses across three core dimensions of mathematics beliefs:

1. Beliefs about the nature of mathematics: This dimension examined participants' perceptions of mathematics as a discipline, including whether they viewed it as a set of rules and procedures, a coherent body of knowledge, or a dynamic process involving problem-solving and creativity.
2. Beliefs about mathematics teaching: This dimension assessed participants' views on effective teaching practices, including the importance of teacher-student interaction, the role of guidance, and the application of pedagogical strategies in the classroom.
3. Beliefs about mathematics learning: This dimension focused on understanding participants' perspectives on how students best learn mathematics, such as through memorization, discovery, or active problem-solving.

The questionnaire employed a Likert scale ranging from strongly agree to strongly disagree, enabling the quantification of participants' beliefs and the identification of patterns within their responses.

**Data Analysis**

The collected data were subjected to descriptive statistical analysis using software tools appropriate for handling survey data. The analysis included:

- Calculation of cluster means: This step involved computing the average responses for each belief dimension to provide an overall summary of participants' agreement or disagreement with the statements.
- Examination of standard deviations: To determine the variability in responses, standard deviations were calculated for each item and dimension, offering insights into the consistency of beliefs among participants.
- Identification of agreement patterns: The analysis focused on identifying which belief statements were most strongly supported or rejected, highlighting areas of consensus or divergence among supervisors. The results were then interpreted to understand how these beliefs align with the roles and responsibilities of external supervisors in the context of mathematics education. This analysis provided actionable insights into how beliefs influence supervision practices and how these perspectives can be used to enhance the effectiveness of teacher training programs.

## RESULTS AND DISCUSSION

### Results

Results from the study are presented based on the research questions asked

*Research Question 1*

To what extent do mathematics student teachers 'external supervisors agree or disagree with each belief about the nature of mathematics? The response to the question is presented in Table 1.

**Table 1.** Beliefs About the Nature of Mathematics

| No | Item | Mean | Standar Deviation | Decision |
|---|---|---|---|---|
| 1 | Mathematics is a collection of rules and procedures that prescribe how to solve a problem | 5.00 | 1.41 | do not reject |
| 2 | Mathematics involves the remembering and application of definitions, formulas, mathematical facts and procedures. | 5.05 | 1.13 | do not reject |
| 3 | Mathematics involves creativity and new ideas. | 4.84 | 1.49 | do not reject |
| 4 | In mathematics many things can be discovered and tried out by oneself. | 4.65 | 1.27 | do not reject |
| 5 | When solving mathematical tasks, you need to know the correct procedure else you would be lost. | 5.11 | 0.85 | do not reject |
| 6 | If you engage in mathematical tasks, you can discover new things (e.g., connections, rules, concepts). | 5.09 | 1.21 | do not reject |
| 7 | Fundamental to mathematics is its logical rigor and preciseness. | 5.07 | 0.74 | do not reject |
| 8 | Mathematical problems can be solved correctly in many ways. | 4.93 | 1.33 | do not reject |
| 9 | Many aspects of mathematics have practical relevance. | 5.07 | 1.12 | do not reject |
| 10 | Mathematics helps solve everyday problems and tasks. | 5.00 | 1.27 | do not reject |
| 11 | To do mathematics requires much practice, correct application of routines, and problem-solving strategies. | 5.30 | 1.01 | do not reject |
| 12 | Mathematics means learning, remembering and applying. | 5.07 | 0.91 | do not reject |
| | **Cluster Mean** | 5.02 | | |

Results from Table 1 show that the respondents do not reject all the items with a cluster mean of 5.02.

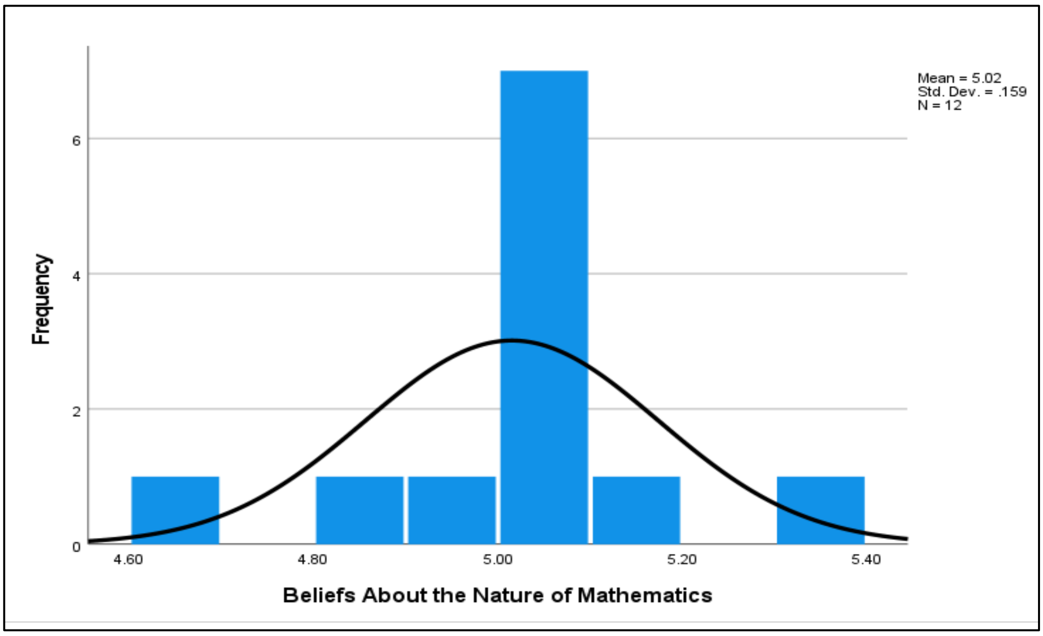


**Figure 2.** Histogram showing the beliefs about the nature of Mathematics

*Research Question 2*

To what extent do mathematics student teachers' external supervisors agree or disagree with each belief about learning mathematics? The response to the research question is presented in Table 2

**Table 2.** Beliefs About Learning Mathematics

| No | Item | Mean | Standar Deviation | Decision |
|---|---|---|---|---|
| 1 | The best way to do well in mathematics is to memorize all the formulas. | 3.65 | 1.59 | Do not Reject |
| 2 | Pupils need to be taught exact procedures for solving mathematical problems. | 4.28 | 1.42 | Do not Reject |
| 3 | It doesn't really matter if you understand a mathematical problem, if you can get the right answer. | 2.61 | 1.37 | Reject |
| 4 | To be good in mathematics you must be able to solve problems quickly. | 3.65 | 1.45 | Do not Reject |
| 5 | Pupils learn mathematics best by attending to the teacher's explanations. | 4.00 | 1.20 | Do not Reject |
| 6 | When pupils are working on mathematical problems, more emphasis should be put on getting the correct answer than on the process followed. | 2.47 | 1.26 | Reject |
| 7 | Non-standard procedures should be discouraged because they can interfere with learning the correct procedure. | 3.86 | 1.41 | Do not Reject |
| 8 | Hands-on mathematics experiences aren't worth the time and expense. | 2.81 | 1.42 | Reject |
| | **Cluster Mean** | 3.43 | | |

Table 2 shows that items 3, 6, and 8 were rejected by the respondents rejected the statements made, with a cluster mean of 3.42.

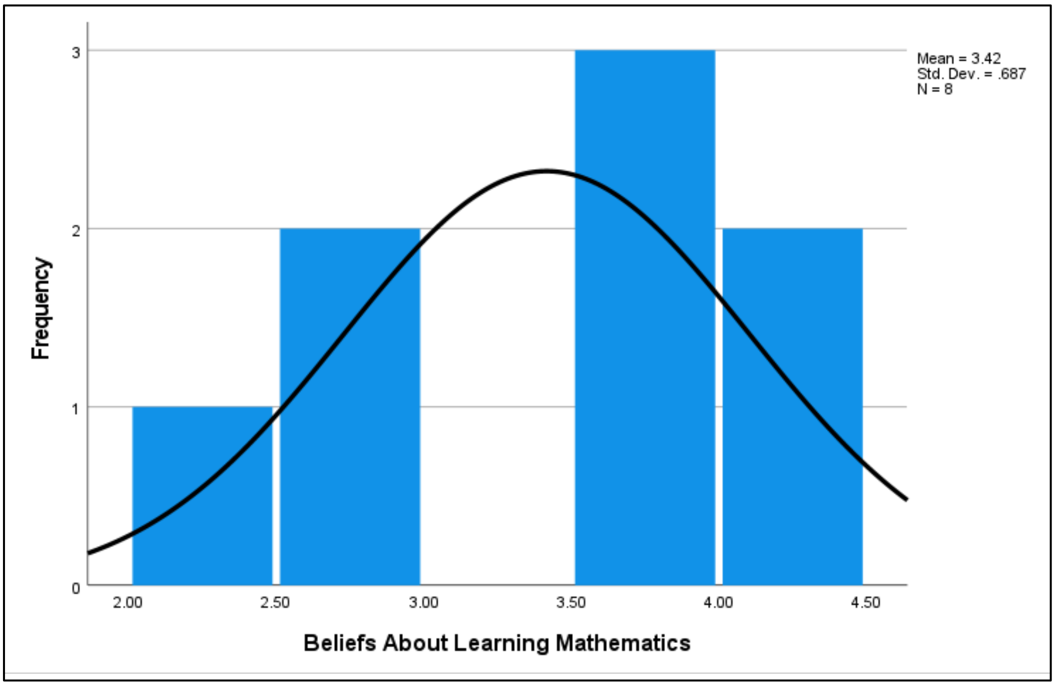


**Figure 3.** Histogram showing the beliefs about learning of Mathematics

*Research Question 3*

To what extent, if at all, are mathematics student teachers' external supervisors prepared for their teaching careers?

**Table 3.** Beliefs About Teaching Mathematics

| No | Item | Mean | Standar Deviation | Decision |
|---|---|---|---|---|
| 1 | Communicate ideas and information about mathematics clearly to pupils. | 4.65 | 1.41 | Do not Reject |
| 2 | Establish appropriate learning goals in mathematics for pupils. | 4.65 | 1.45 | Do not Reject |
| 3 | Set up mathematics learning activities to help pupils achieve learning goals. | 4.93 | 1.40 | Do not Reject |
| 4 | Use questions to promote higher order thinking in mathematics. | 4.56 | 1.52 | Do not Reject |
| 5 | Use computers and ICT (information and communication technologies) to aid in teaching mathematics. | 4.19 | 1.59 | Do not Reject |
| 6 | Challenge pupils to engage in critical thinking about mathematics. | 4.79 | 1.47 | Do not Reject |
| 7 | Establish a supportive environment for learning mathematics. | 4.88 | 1.42 | Do not Reject |
| 8 | Use assessment to give effective feedback to pupils about their mathematics learning. | 5.09 | 1.17 | Do not Reject |
| 9 | Provide parents with useful information about your pupils' progress in mathematics. | 5.11 | 1.38 | Do not Reject |
| 10 | Develop assessment tasks that promote learning in mathematics. | 5.11 | 1.35 | Do not Reject |
| 11 | Incorporate effective classroom management strategies into your teaching of mathematics. | 5.00 | 1.25 | Do not Reject |
| 12 | Have a positive influence on difficult or unmotivated pupils. | 4.91 | 1.44 | Do not Reject |
| 13 | Work collaboratively with other teachers. | 5.16 | 1.40 | Do not Reject |
| | **Cluster Mean** | 5.02 | | |

Results from Table 3 show that the respondents do not reject all the items under this particular research question.

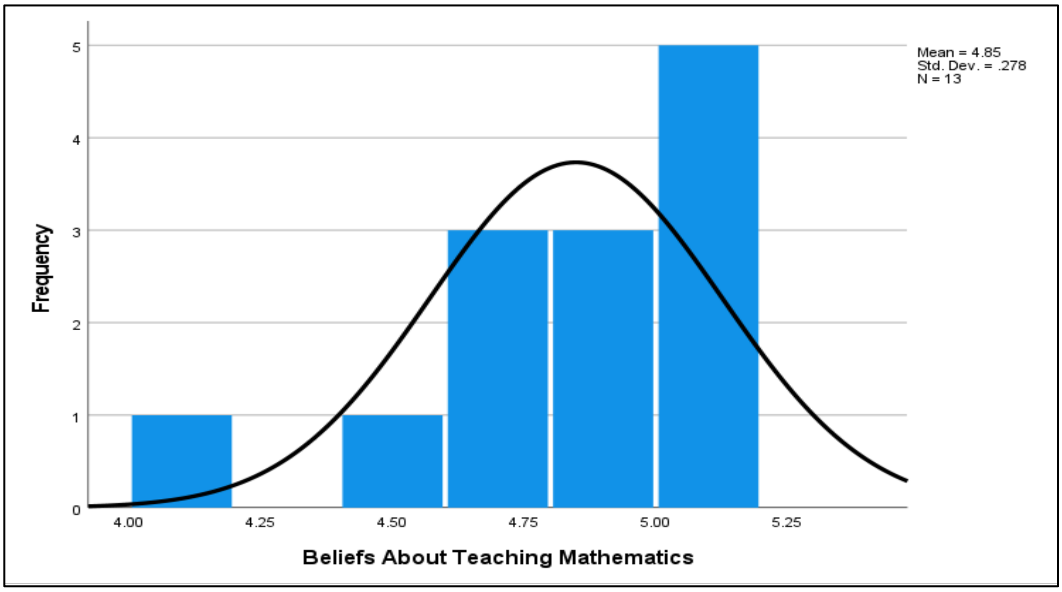


**Figure 4.** Histogram showing the beliefs about teaching of Mathematics

It appears that the external supervisors were well prepared in terms of communicating ideas and information about mathematics clearly to pupils; Setting up mathematics learning activities to help pupils achieve learning goals; and using assessment to give effective feedback to pupils about their mathematics learning for example. Surprisingly, if these supervisors claimed to have been well prepared regarding all the above indicators, their view of the nature and learning and teaching of mathematics should have been different compared to what they reflected in Tables 1 and 2.

## Discussion

### *The Nature of Mathematics*

The study investigated Mathematics student teachers 'external supervisors' beliefs about Mathematics in an ODeL environment. The results show that the respondents agree with the beliefs about the nature of mathematics. It is evident from Table and Figure 1 that mathematics student teachers' external supervisors believe that mathematics is a collection of procedures and rules that prescribe how to solve a problem (Charalambides et al., 2023; Erşen et al., 2021). This implies that these supervisors view mathematics as a subject that has prescribed or memorised rules, and methods. It is viewed as a step-by-step procedure that is used to solve a problem. Liu et al. (2019) emphasized that students who adopt diverse learning strategies, rather than relying solely on memorization, tend to achieve better outcomes in mathematics. Similarly, Kaur and Prendergast (2022) highlighted that integrating writing as a tool for expressing mathematical ideas boosts students' confidence and engagement, underscoring the value of approaches beyond rote memorization. While these learners recognize the importance of mathematics in school, they may lack a deeper understanding of its essence and the process of engaging with mathematical concepts. Their conception of mathematics often reduces it to a set of rules, arithmetic calculations, or abstract algebraic and geometric constructs, seen merely as prerequisites for passing exams (Gomides et al., 2020; Spiller et al., 2023). This finding aligns with the views expressed by Irez (2007), Beswick (2008), and Ngoako (2018), who emphasize the significance of teachers' beliefs regarding the nature of mathematics. The research results indicate that respondents, with an average score of 5.30, agree that proficiency in mathematics necessitates extensive practice, correct application of algorithms, and effective problem-solving strategies. Conversely, respondents with the lowest average score of 4.65 also acknowledge the potential for individual exploration and discovery in mathematics, suggesting a nuanced understanding of mathematical learning.

However, despite feeling prepared in terms of providing feedback and setting learning objectives (Tabel 3), the external supervisors' views on mathematics as a discipline remain heavily influenced by instrumentalist perspectives (Tabel 1 and 2). This discrepancy suggests that their readiness is more aligned with the administrative aspects of supervision, while a conceptual understanding of mathematics as a dynamic field requires further attention. This observation is consistent with Liu et al. (2019) and Ernest (1989), who stress the need for broader pedagogical frameworks to balance procedural fluency and deeper conceptual understanding. Additional training is needed to bridge this gap, enabling supervisors to approach mathematics instruction with greater emphasis on exploration and creativity.

### *Teaching and learning of Mathematics*

Regarding teaching and learning mathematics, it appears from Table 2 and Figure 2 that most supervisors believe that the best approach to mathematics is memorizing all the formulas. They believe that, for example, learners need to be taught exact mathematical problem-solving procedures. A significant portion of the limited (and sometimes negative) perspective on mathematics originates from highly authoritarian, or what some refer to as "traditional," teaching methods (Chowdhuri, 2022; Kasimatis et al., 2020). In such instructional approaches, often labeled as "traditional," the teacher assumes a primarily didactic role, presenting mathematical concepts or ideas to students (Hendriyanto et al., 2024; Plesec Gasparic et al., 2024). Students are then instructed on how to apply these concepts in a predetermined manner to arrive at the correct solution. They practice these methods and rely on the teacher to provide them with the correct answers. This teaching method tends to foster a compliance-based, computation-focused, outcome-driven perception of mathematics (Anggraeni et al., 2022; Lämsä et al., 2023). Students exposed to this instructional style tend to adopt the belief that every problem has only one correct solution and that they cannot solve a problem without being provided with a pre-determined "solution method." Often, these "rules" seem arbitrary to students, leading to a lack of enthusiasm in lessons, especially when they struggle to recall the prescribed rule. Consequently, many educators concur that "when tackling mathematical problems, familiarity with the correct procedure is essential, or one may feel disoriented."

The findings of the study further revealed that the mathematics pre-service teachers' external supervisors disagree with each belief about learning mathematics. Particularly the respondents rejected the item that states that "When pupils are working on mathematical problems, more emphasis should be put on getting the correct answer than on the process followed." This implies that emphases are to be made on both getting the correct and the process of getting the correct answer in the teaching process. Studies such as Beswick (2012) and Genc and Erbas (2019) reveal that many educators view mathematics as a set of rules and procedures, emphasizing rote learning over a conceptual or Platonist perspective.However, the respondents agreed that "Pupils learn mathematics best by attending to the teacher's explanations." In this regard, serious attention should be given to giving detailed explanations of mathematical concepts when teaching. The integration of procedural fluency ("what to do") and conceptual understanding ("why to do it") is crucial in mathematics education, as supported by Stella et al. (2020), Hoch et al. (2021), and Krause-Wichmann et al. (2023), to enhance problem-solving skills and foster adaptable, comprehensive learning. Furthermore, there is a need for developmental programs that focus on innovative approaches to mathematics teaching. These programs could integrate workshops based on case studies (Beswick, 2012), simulations of supervision with an emphasis on collaboration and exploration (Nührenbörger et al., 2024), and the use of modern technologies to support instruction (Gumbo & Gasa, 2023). Such initiatives would help supervisors better understand how to align traditional methods with more dynamic, student-centered teaching strategies.

***Preparedness of Supervisors***

Regarding the issue of the external supervisor being prepared when beginning their teaching career, it appears that the external supervisors were well prepared in terms of communicating ideas and information about mathematics clearly to pupils; Setting up mathematics learning activities to help pupils achieve learning goals; using assessment to give effective feedback to pupils about their mathematics learning for example. Surprisingly, if these supervisors claimed to have been well prepared regarding all the above indicators, their view of the nature and learning and teaching of mathematics should have been different compared to what they reflected in Tables 1 and 2.

Again, the study revealed that the respondents to a very large extent agreed with activities such as "Work collaboratively with other teachers" in preparing for the teaching of mathematics. With the very high cluster mean of 4.85, as shown in the result, it shows that the respondents agreed with all the items about the beliefs in the teaching of mathematics. This finding agrees with Marshman and Goos (2018) who state that the notion of mathematics held by the teacher is comprised of all of his or her beliefs about the subject. Nonetheless, these results highlight an apparent gap between the perceived readiness of supervisors and their actual instructional beliefs. To address this, Marshman and Goos (2018) emphasize the importance of structured training programs that target conceptual beliefs about mathematics, shifting the focus from procedural adherence to exploratory learning. Such reforms would align supervisors' perceptions with modern pedagogical needs, ensuring their effectiveness in ODeL settings.

## CONCLUSION

This research uncovers that although external supervisors demonstrate technical preparedness in areas such as feedback delivery and goal setting, their views on mathematics lean heavily towards an instrumentalist approach. This perspective prioritizes procedural understanding over conceptual and exploratory learning. The findings underscore the critical need for specialized training programs that include collaborative methods, case-driven workshops, and the integration of modern technologies tailored for ODeL environments. Implementing these programs would help address the existing gaps between traditional supervisory approaches and contemporary educational needs. Furthermore, equipping supervisors with these skills would enhance their capacity to support student teachers effectively, fostering a deeper understanding of mathematics among learners. By tackling these challenges, institutions like UNISA can elevate the standards of mathematics education supervision, creating a lasting impact on the teaching practices of future educators.

## AUTHOR CONTRIBUTIONS STATEMENT

Masilo France Machaba spearheaded the conceptual framework and research design, taking the lead in analyzing the results and drafting the introduction and conclusion sections.
Terungwa James Age played a pivotal role in managing data collection and conducting statistical analyses. He also contributed to interpreting the findings and refining the methodology section. As the corresponding author, he facilitated all communications with the journal and ensured smooth submission and revision processes.
Puleng Edwin Rankweteke conducted an extensive literature review and ensured the integration of relevant references throughout the manuscript. He also played a key role in editing and refining the discussion section, ensuring coherence and a high standard of presentation for the study.

## REFERENCES

Álvarez, C. de la P., Fernádez-Cézar, R., & Solano-Pinto, N. (2021). Attitude Toward Mathematics of Future Teachers: How Important Are Creativity and Cognitive Flexibility? *Frontiers in Psychology*, *12*. https://doi.org/10.3389/fpsyg.2021.713941

Anggraeni, N. F., Rahayu, S., Fajaroh, F., & Effendy, E. (2022). The Effectiveness of the EIGER Learning Strategy in Promoting Students' Conceptual and Algorithmic Understanding of Stoichiometry. *International Journal of Instruction*, *15*(4). https://doi.org/10.29333/iji.2022.1543a

Beswick, K. (2008). Influencing Teachers' Beliefs about Teaching Mathematics for Numeracy to Students with Mathematics Learning Difficulties. *Mathematics Teacher Education and Development*, *9*, 3–20.

Beswick, K. (2012). Teachers' beliefs about school mathematics and mathematicians' mathematics and their relationship to practice. *Educational Studies in Mathematics*, *79*(1), 127–147. https://doi.org/10.1007/s10649-011-9333-2

Charalambides, M., Panaoura, R., Tsolaki, E., & Pericleous, S. (2023). First Year Engineering Students' Difficulties with Math Courses- What Is the Starting Point for Academic Teachers? *Education Sciences*, *13*(8). https://doi.org/10.3390/educsci13080835

Chowdhuri, M. N. (2022). Exploring modes of engagement within reform-oriented primary mathematics textbooks in India. *Educational Studies in Mathematics*, *110*(2). https://doi.org/10.1007/s10649-021-10135-z

Desai, A. J. (2012). Problems of teacher education in India. *International Journal*, *1*(1), 54–58.

Ernest, P. (1989). The impact of beliefs on the teaching of mathematics. *Mathematics Teaching: The State of the Art*, *249*, 254.

Erşen, Z. B., Akın, N. P., & Karakuş, F. (2021). Investigation of Prospective Preschool Teachers' Beliefs about Mathematics Teaching and Learning. *Mimbar Sekolah Dasar*, *8*(2). https://doi.org/10.53400/mimbar-sd.v8i2.33486

Genc, M., & Erbas, A. K. (2019). Secondary mathematics teachers' conceptions of mathematical literacy. *International Journal of Education in Mathematics, Science and Technology*, *7*(3), 222–237.

Gomides, M. R. de A., Starling-Alves, I., Paiva, G. M., Caldeira, L. da S., Aichinger, A. L. P. N., Carvalho, M. R., Bahnmueller, J., Moeller, K., Lopes-Silva, J. B., & Haase, V. G. (2020). *The quandary of diagnosing mathematical difficulties in a generally low performing population*. Scite.Ai. https://doi.org/10.31234/osf.io/5dmhs

Gumbo, M. T., & Gasa, V. (2023). Postgraduate supervision support in Open Distance and E-learning: Supervisors' and key stakeholders' views. *South African Journal of Higher Education*, *37*(4). https://doi.org/10.20853/37-4-5318

Hendriyanto, A., Suryadi, D., Juandi, D., Dahlan, J. A., Hidayat, R., Wardat, Y., Sahara, S., & Muhaimin, L. H. (2024). The didactic phenomenon: Deciphering students' learning obstacles in set theory. *Journal on Mathematics Education*, *15*(2). https://doi.org/10.22342/jme.v15i2.pp517-544

Hoch, E., Scheiter, K., Stalbovs, K., & Gerjets, P. (2021). The intention was good: How promoting strategy use does not improve multimedia learning for secondary students. *British Journal of Educational Psychology*, *91*(4). https://doi.org/10.1111/bjep.12417

Irez, S. (2007). Reflection-oriented qualitative approach in beliefs research. *Eurasia Journal of Mathematics, Science and Technology Education*, *3*(1), 17–27. https://doi.org/10.12973/ejmste/75370

Jin, L., Banda, L. O. L., Banda, J. T., & Hui, Z. W. (2021). *Learner support and professional development during teaching practice? Should supervisors be subject specialists or any lecturers?* Research Square. https://doi.org/10.21203/rs.3.rs-1139179/v1

Johnson, A., Peter, G., & Kirimi, F. (2019). Implications of Academic Staff Participation in Teaching Practice on the Quality of Bachelor of Education Program in Selected Public Universities in Kenya. *Journal of Education and Training*, *6*(1). https://doi.org/10.5296/jet.v6i1.14107

Jojo, Z. (2022). Engaging mathematics student-teachers in an Open Distance e-learning context. *Perspectives in Education*, *40*(1). https://doi.org/10.18820/2519593x/pie.v40.i1.12

Kalchman, M. (2011). Preservice teachers' changing conceptions about teaching mathematics in urban elementary classrooms. *Journal of Urban Mathematics Education*, *4*(1), 75–97. https://doi.org/10.21423/jume-v4i1a97

Kasimatis, K., Moutsios-Rentzos, A., Matzakos, N., Rozou, V., & Kouloumpis, D. (2020). Effective mathematics teaching in tertiary technological education: The case of ASPETE. *New Trends and Issues Proceedings on Humanities and Social Sciences*, *7*(1). https://doi.org/10.18844/prosoc.v7i1.4888

Kaur, T., & Prendergast, M. (2022). Students' perceptions of mathematics writing and its impact on their enjoyment and self-confidence. *Teaching Mathematics and Its Applications: An International Journal of the IMA*, *41*(1), 1–21. https://doi.org/10.1093/teamat/hrab008

Krause-Wichmann, T., Greisel, M., Wekerle, C., Kollar, I., & Stark, R. (2023). Promoting future teachers' evidence-informed reasoning scripts: Effects of different forms of instruction after problem-solving. *Frontiers in Education*, *8*. https://doi.org/10.3389/feduc.2023.1001523

Lämsä, J., Virtanen, A., Tynjälä, P., Maunuksela, J., & Koskinen, P. (2023). Exploring students' perceptions of self-assessment in the context of problem solving in STEM. *LUMAT: International Journal on Math, Science and Technology Education*, *11*(2). https://doi.org/10.31129/lumat.11.2.2028

Lehong, S., Biljon, J. van, & Sanders, I. (2019). Open-distance electronic learning environments: Supervisors' views on usability. *2019 Conference on Information Communications Technology and Society (ICTAS)*. https://doi.org/10.1109/ictas.2019.8703605

Liu, Q., Du, X., Zhao, S., Liu, J., & Cai, J. (2019). The role of memorization in students' self-reported mathematics learning: A large-scale study of Chinese eighth-grade students. *Asia Pacific Education Review*, *20*(3), 361–374. https://doi.org/10.1007/s12564-019-09576-2

Mahmudi, A. (2021). An analysis of mathematics understanding of prospective student-teachers of mathematics. *Jurnal Riset Pendidikan Matematika*, *8*(2). https://doi.org/10.21831/jrpm.v8i2.44422

Marshman, M., & Goos, M. (2018). The Beliefs about Mathematics, Its Teaching and Learning of Those Involved in Secondary Mathematics Pre-Service Teacher Education. *Mathematics Education Research Group of Australasia*. https://eric.ed.gov/?id=ED592540

McLeod, D. B., & McLeod, S. H. (2002). Synthesis — Beliefs and Mathematics Education: Implications for Learning, Teaching, and Research. *Beliefs: A Hidden Variable in Mathematics Education?* https://doi.org/10.1007/0-306-47958-3_7

Naphiyo, J. M., & Kamwamba, A. E. (2024). ODeL and Massification in Higher Education Institutions in Malawi: Challenges and Opportunities. *International Journal of Research and Innovation in Social Science*, *VIII*(VII). https://doi.org/10.47772/ijriss.2024.807066

Ng, S., Mylopoulos, M., Kangasjarvi, E., Boyd, V., Teles, S., Orsino, A., Lingard, L., & Phelan, S. (2020). Critically reflective practice and its sources: A qualitative exploration. *Medical Education*, *54*(4). https://doi.org/10.1111/medu.14032

Ngoako, R. N. (2018). *The beliefs of educators about effective mathematics classroom practice in Grade 6* [Master's Thesis, University of Pretoria (South Africa)]. https://search.proquest.com/openview/da0cfd222195162e390dfa377f033e6e/1?pq-origsite=gscholar&cbl=2026366&diss=y

Nührenbörger, M., Wember, F. B., Wollenweber, T., Frischemeier, D., Korten, L., & Selter, C. (2024). Development of teachers' attitudes and self-efficacy expectations for inclusive mathematics instruction: Effects of online and blended learning programs. *Journal of Mathematics Teacher Education*. https://doi.org/10.1007/s10857-024-09624-8

OECD. (2009). *Teaching Practices, Teachers' Beliefs and Attitudes* (pp. 87–135). OECD. https://doi.org/10.1787/9789264068780-6-en

Peker, M., & Ulu, M. (2018). The Effect of Pre-service Mathematics Teachers' Beliefs about Mathematics Teaching-Learning on Their Mathematics Teaching Anxiety. *International Journal of Instruction*, *11*(3). https://doi.org/10.12973/iji.2018.11318a

Pelikan, E. R., Korlat, S., Reiter, J., Holzer, J., Mayerhofer, M., Schober, B., Spiel, C., Hamzallari, O., Uka, A., Chen, J., Välimäki, M., Puharić, Z., Anusionwu, K. E., Okocha, A. N., Zabrodskaja, A., Salmela-Aro, K., Käser, U., Schultze-Krumbholz, A., Wachs, S., … Lüftenegger, M. (2021). Distance learning in higher education during COVID-19: The role of basic psychological needs and intrinsic motivation for persistence and procrastination–a multi-country study. *PLOS ONE*, *16*(10), e0257346. https://doi.org/10.1371/journal.pone.0257346

Plesec Gasparic, R., Glavan, M., Žveglič Mihelič, M., & Valenčič Zuljan, M. (2024). Effectiveness of Flipped Learning and Teaching: Knowledge Retention and Students' Perceptions. *Journal of Information Technology Education: Research*, *23*. https://doi.org/10.28945/5237

Shahali, E. H. M., & Halim, L. (2024). The Influence of Science Teachers' Beliefs, Attitudes, Self-efficacy and School Context on Integrated STEM Teaching Practices. *International Journal of Science and Mathematics Education*, *22*(4), 787–807. https://doi.org/10.1007/s10763-023-10403-9

Skemp, R. R. (2012). *The psychology of learning mathematics: Expanded American edition*. Routledge. https://doi.org/10.4324/9780203396391

Smith, C. (2014). *Gender and participation in mathematics and further mathematics A-levels: A literature review for the Further Mathematics Support Programme*. https://oro.open.ac.uk/50365/1/Gender%20Literature%20Review%20UCL%20IOE%20Final.pdf

Spiller, J., Clayton, S., Cragg, L., Johnson, S., Simms, V., & Gilmore, C. (2023). Higher level domain specific skills in mathematics; The relationship between algebra, geometry, executive function skills and mathematics achievement. *Plos One*, *18*(11). https://doi.org/10.1371/journal.pone.0291796

Texas State University, & Gordon, S. (2023). Supervision, Teaching, and Learning in Successful Schools: A Hall of Mirrors. *Journal of Educational Supervision*, *6*(3), 1–24. https://doi.org/10.31045/jes.6.3.1

Tian, Y., & Guo, Q. (2023). Supervisory Feedback on Chinese Doctoral Students' Drafts of a Research Article. *Education Sciences*, *13*(7). https://doi.org/10.3390/educsci13070731

Van Eycken, L., Demanet, J., & Van Houtte, M. (2024). Teachers' efficacy, trust, and students' features: Internal and external forces affecting teachers' teachability perceptions. *Social Psychology of Education*, *27*(3), 1387–1412. https://doi.org/10.1007/s11218-023-09865-0

Vela, M. K. G. A. de, & Pelayo, R. (2022). An Exploration of the Supervisory Perceptions, Practices and Teachers Assessment of Needs: A Basis for The Formulation of Supervisory Strategies in School. *Academy of Educational Leadership Journal*, *26*(1), 1–15.

Yang, Y., Maeda, Y., & Gentry, M. (2024). The relationship between mathematics self-efficacy and mathematics achievement: Multilevel analysis with NAEP 2019. *Large-Scale Assessments in Education*, *12*(1), 16. https://doi.org/10.1186/s40536-024-00204-z