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Solid Foundation, Teacher's Competency, and Learner Support as Determinants of Learners' Interest in Learning Geometry

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ABSTRACT

The study aimed to explore the relationship between a solid foundation in geometry and learners' interest in learning geometry, the extent to which teacher competency influences learners' interest in learning geometry and how the availability of learner support impacts learners' interest in learning geometry. The study employed a theoretical framework combining the Social Cognitive Theory, Self-Determination Theory, and the Conceptual Change Model as the lens to analyse the collected data on the topic. The study employed a theoretical framework combining the Social Cognitive Theory, Self-Determination Theory, and the Conceptual Change Model as the lens to analyse the collected data on the topic. The study employed a systematic sampling technique to select 60 learners (20 from each of the selected schools in the circuit, (Grade 10= 26 and Grade 11= 34). After testing the three null hypotheses, each at a 0.05 significance level, two were rejected and one was accepted. The results indicate that a strong foundation in geometry and adequate support for learners significantly enhance learners' interest in solving geometry problems. The implications of these results can lead to the possible development of the following: a curriculum that emphasises core geometric concepts, interdisciplinary projects in which geometry is connected to real-life scenarios and Project-Based Learning, thus fostering a more profound understanding and interest. Furthermore, the results implore teachers to use personalised learning through differentiated assignments, promote active learning techniques by incorporating hands-on activities, create a collaborative learning environment and enhance geometry instruction, such as software licenses, manipulatives, and teacher training workshops. Finally, the study suggests teachers use assessments that measure computational skills, problem-solving abilities, and conceptual understanding of geometry, promoting a more comprehensive evaluation of learner progress.

Keywords: *Foundation, Geometry, Interest, Learner, Support, Teacher*

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INTRODUCTION

Geometry, as a branch of mathematics, is pivotal in shaping learners' cognitive and analytical abilities (Jablonski & Ludwig, 2023). Acquiring geometrical knowledge is crucial for academic success and developing critical thinking skills and problem-solving abilities. This study delves into the multifaceted factors influencing learners' interest in learning geometry, focusing on the interplay between a solid foundation and learner support.

BACKGROUND

Geometry education is a cornerstone in the broader mathematics curriculum, offering learners a unique opportunity to explore spatial relationships, logical reasoning, and abstract thinking (Nabavi & Fossen, 2021). A solid foundation in geometry involves a comprehensive understanding of fundamental concepts such as points, lines, angles, shapes, and spatial measurements (Cao, Yan, He & He, 2020). Without a strong groundwork in these foundational elements, learners may struggle to grasp more advanced geometrical principles. The role of teachers in shaping learners' attitudes and interest in learning geometry cannot be overstated. Teacher competency encompasses a deep understanding of the subject matter and effective pedagogical strategies, enthusiasm and the ability to make abstract concepts relatable to learners' everyday experiences (Khalmurzayevna, & Zairjanovich, 2023). A proficient and engaging teacher can inspire curiosity and foster a positive attitude towards geometry, influencing learners to actively participate and invest in their learning.
Furthermore, inside and outside the classroom, learner support significantly contributes to learners' interest in geometry. Adequate resources, interactive learning materials, and a supportive learning environment are essential to creating a positive learning experience (Ferri, Grifoni & Guzzo, 2020). Additionally, recognising and catering to diverse learning styles ensures that learners with varying strengths and preferences can engage with geometry in a way that suits their needs. This study investigated the intricate connections between a solid foundation, teacher competency, and learner support influencing learners' interest in geometry. By identifying the relative impact of each factor and exploring potential synergies, educators can gain valuable insights into practical strategies for enhancing learners' engagement and achievement in geometry education.

PROBLEM STATEMENT

Despite geometry's importance in real-life situations, many learners still face challenges conceptually understanding it. The study investigated the influence of solid foundation, teacher's competency, and learner support on learners' interest in geometry. As learners engage with geometric concepts, the role of foundational solid knowledge, the effectiveness of teachers in delivering the curriculum, and the availability of adequate learner support become pivotal factors in shaping the level of interest and enthusiasm exhibited by learners in the study of geometry (Luneta, 2014).

Understanding the interplay between these variables is essential for enhancing educational strategies and interventions to promote a sustained interest in geometry among learners (Hamza, 2018). This research seeks to address the gaps in the existing literature by exploring the multifaceted

relationship between a solid foundation, teacher competency, learner support, and the resultant impact on learners' interest in learning geometry.

RESEARCH QUESTIONS

1. What is the relationship between a solid foundation in geometry and learners' interest in geometry?
2. To what extent does teacher competency influence learners' interest in geometry?
3. How does the availability of learner support impact learners' interest in learning geometry?

The following three null hypotheses each were tested at a 0.05 level of significance:

(i) H_0: There is no significant relationship between a solid geometry foundation and learners interested in solving geometry problems.

(ii) H_0: There is no significant relationship between the teacher's geometry competence and learners' interest in geometry.

(iii) H_0: There is no significant relationship between support given to the learners in solving geometry and learners' interest in geometry.

LITERATURE REVIEW

Solid Foundation in Geometry

A solid foundation in geometry is a fundamental prerequisite for learners embarking on a journey through mathematical education. Geometry, as a branch of mathematics, not only serves as an academic discipline but also plays a crucial role in developing essential cognitive skills, logical reasoning, and problem-solving abilities to understand other mathematics topics (Olkun & Sarı, 2016; Davis & The Spatial Reasoning Study Group, 2015). The significance of having a solid foundation in geometry and its far-reaching implications for academic success and lifelong learning.

Geometry, derived from the Greek words "geo" (earth) and "metron" (measure), is the study of shapes, sizes, and properties of space. From ancient civilizations to today, geometry has been a cornerstone of mathematical understanding, providing a framework for comprehending the spatial relationships that govern the physical world (Serin, 2018). A solid foundation in geometry involves a comprehensive grasp of fundamental concepts such as points, lines, angles, shapes, and spatial measurements.

The need for a strong geometry foundation becomes evident as learners progress through their mathematical education. Geometry serves as a bridge between arithmetic and more advanced branches of mathematics (Harel, 2014). It introduces abstract thinking, deductive reasoning, and logical proofs, which are integral components of mathematical literacy. This implies that without a solid grounding in geometry, learners may face challenges when dealing with higher-level mathematical concepts and applications.

Furthermore, geometry has practical applications beyond the classroom, for example, everyday activities, ranging from navigating a city to designing structures, involve geometric principles. A solid foundation in geometry equips individuals with the spatial awareness and analytical skills needed to tackle real-world problems (Angraini & Prahmana, 2019). It is not merely an academic exercise but a key element in fostering critical thinking and analytical reasoning, skills that are invaluable in various professions and daily life.

A solid foundation in geometry is paramount for learners as they navigate the intricate landscape of mathematical

education. Beyond its academic significance, geometry lays the groundwork for critical thinking, problem-solving, and spatial reasoning skills essential for success in both educational and practical contexts (Harel, 2014). Recognizing the importance of a geometry foundation is crucial in ensuring that learners are well-prepared for the challenges of advanced mathematics and equipped with skills that extend far beyond the confines of the classroom.

Secondary School Teachers' Competency in Euclidean Geometry

The study explored the importance of teachers' competency in Euclidean geometry within the South African secondary school context, shedding light on its impact on learners' learning outcomes and the broader educational landscape. The competency of secondary school teachers in Euclidean geometry is a critical aspect of mathematics education that significantly influences learners' understanding and performance in this mathematical discipline (Mamolo & Sugano, 2020; Refugio, Galleto, Noblefranca, Inoferio, Macias Jr, Colina & Dimalig, 2020). Teachers' proficiency in geometry influences learners' academic achievements and contributes to the broader goals of cultivating critical thinking and problem-solving skills. Recognizing the importance of teacher competency in Euclidean geometry is crucial for advancing the quality of mathematics education in South African secondary schools and preparing learners for academic success and future endeavours. Geometry provides the foundation for spatial reasoning and logical deduction needed in real life when solving problems.

Mathematics education in South African secondary schools is a key component of fostering analytical thinking and problem-solving skills among learners. Euclidean geometry, characterized by its emphasis on geometric shapes, angles, and proofs, occupies a central place in the curriculum. The teaching of Euclidean geometry requires educators not only to possess a profound understanding of the subject matter but also to employ pedagogical strategies that make these abstract concepts accessible and engaging to learners. For example, Van Niekerk (2010) argues that the teaching and learning of geometry should be learner-centred. Learners-centredness allows learners to work on the given question using different strategies flexibly.

The strategies to promote learner-centeredness in the classroom encompass various pedagogical approaches. Cooperative learning or group work, discovery learning, team teaching, guided discovery, peer tutoring, brainstorming, demonstration methods, mathematics centres, and the use of technology have all been highlighted as effective strategies to foster a learner-centred environment (Bernard, Borokhovski, Schmid, Waddington & Pickup, 2019). Many mathematics teachers do not use diverse strategies when teaching geometry, leaving many learners bankrupt of geometric skills. In this vein, research has highlighted the need for mathematics teachers to employ diverse geometry teaching strategies, as traditional methods often promote rote learning and fail to instil creativity in learners (Shukla, 2019).

The competency of secondary school teachers in Euclidean geometry encompasses several dimensions. Firstly, teachers need a solid grasp of the foundational principles of Euclidean

geometry, including axioms, theorems, and geometric constructions. Secondly, effective communication and instructional skills are essential for conveying complex geometric ideas in a way that resonates with diverse learners. Additionally, teachers should be adept at incorporating real-world applications of geometry, illustrating its relevance beyond the confines of the classroom.

Given the diversity of South Africa's learner population, teachers must be attuned to the various learning styles and abilities present in their classrooms (Gonzales & Moreno, 2022). Competent teachers can adapt their instructional approaches to accommodate different learners, fostering an inclusive and supportive learning environment. Furthermore, professional development opportunities and ongoing training can enhance teachers' competency in Euclidean geometry, ensuring they stay abreast of evolving educational methodologies and curriculum requirements.

Support That Learners Need to Learn Geometry

Learners can benefit from various forms of support when learning geometry due to its abstract nature and the need for visualization and spatial reasoning. The types of support that can enhance the learning experience include the following:

Visual Aids and Tools

Diagrams and Illustrations: Visual aids such as diagrams and illustrations help learners visualise geometric concepts. Teachers can use whiteboards, charts, or multimedia presentations to enhance understanding. Geometric Tools: Provide learners with rulers, compasses, protractors, and graph paper to experiment and practice geometric constructions. These aids are precious in geometry education, where visualisation skills are essential for comprehending abstract concepts (Dahal, Pant, Shrestha., & Manandhar, 2022).

Real-life Applications

Contextualising Concepts: Connect geometric concepts to real-world applications. For example, demonstrate how geometry is used in architecture, engineering, art, or everyday situations. This helps learners understand the practical relevance of what they are learning.

Hands-On Activities

Manipulatives: Use physical objects, like geometric shapes or models, to allow learners to manipulate and explore concepts. This hands-on approach helps reinforce understanding and provides a tangible experience.

Puzzles and Games: Introduce geometry through puzzles and games that challenge learners to apply geometric principles in a fun and interactive way.

Technology Integration

Using technology in the teaching and learning of geometry improves learners' performance if properly integrated teaching and learning of geometry (Mamali, 2015). Technology can be integrated as:

Geometry Software: Utilize geometry software and interactive apps that allow learners to explore and experiment with geometric concepts dynamically and engagingly.

Virtual Reality (VR) and Augmented Reality (AR): Incorporate VR or AR experiences to provide immersive and three-dimensional learning environments.

Differentiated Instruction

Adapt to Learning Styles: Recognize and accommodate diverse learning styles. Some learners may grasp concepts better through visual aids, while others may benefit more from verbal explanations or hands-on

activities.

SUPPORTIVE LEARNING ENVIRONMENT

Encourage Questions*:* Foster an environment where learners feel comfortable asking questions. Geometry often involves abstract concepts, and addressing learner queries can help clarify misunderstandings.

Peer Collaboration: Promote collaborative learning through group activities. Discussing concepts with peers can provide additional perspectives and insights.

Progressive Learning

Sequential Instruction: Break down geometric concepts into sequential steps. This helps learners build a foundation and progressively advance to more complex ideas.

Scaffolded Instruction: Provide support structures or scaffolding to help learners grasp challenging concepts gradually.

Formative Assessment

Feedback: Offer constructive and timely feedback on learner performance. This helps identify areas of improvement and reinforces correct understanding. By combining these forms of support, educators can create a more comprehensive and practical learning experience for learners studying geometry.

THEORETICAL FRAMEWORK

To analyse the relationship between "Solid foundation, teacher's competency, and learner support as determinants on learners' interest in learning geometry," the study employed a theoretical framework that integrates elements from various educational and psychological theories. The study employed a theoretical framework combining the Social Cognitive Theory, Self-Determination Theory, and the Conceptual Change Model as the lens to analyse the collected data on the topic. Each one of the three theories is a brief explanation below:

Social Cognitive Theory (SCT), developed by Albert Bandura (1965), emphasises the role of observational learning, imitation, and modelling in the learning process. This study uses this theory to understand how learners observe and imitate behaviours related to geometry learning based on the solid foundation, teacher competency, and learner support.

Self-Determination Theory (SDT), developed by Richard Ryan and Edward Deci (2000), focuses on autonomy, competence, and relatedness in fostering intrinsic motivation. The application of SDT has assisted in exploring how learners' interest in learning geometry may be influenced by their sense of autonomy (solid foundation), competence (teacher's competency), and relatedness (learner support).

The conceptual Change Model developed by Pintrich and Mayer (1999) addressed how learners develop new understanding by modifying or replacing existing concepts. The Conceptual Change Model was used to explore how a solid foundation in geometry, effective teaching practices (teacher's competency), and supportive learning environments (learner support) contribute to changes in learners' conceptual understanding and interest in geometry. By integrating these theories, the theoretical framework guided the development of research questions, hypotheses, and data analysis methods for this study.

METHODOLOGY

Research Paradigm

Overall, the research paradigm for this study aligns with a pragmatist perspective, aiming to address the research questions through a

combination of quantitative and qualitative methods, emphasising the practical implications and applications of the study's findings in enhancing learners' interest in learning geometry.

Research Methodology

The research paradigm for the study on "Solid foundation, teacher's competency, and learner support as determinants on learners' interest in learning geometry" can be framed within a mixed-methods approach. This approach combines quantitative and qualitative research methods to comprehensively understand the complex interplay between the identified variables.

The quantitative phase of the research involved using structured questionnaires to collect numerical data on variables such as the level of learners' interest in learning geometry, the perceived strength of their foundation in geometry, the effectiveness of teachers in delivering geometry content, and the adequacy of learner support.

The qualitative phase includes in-depth interviews, focus group discussions, and open-ended survey questions to explore learners' and teachers' experiences, perceptions, and insights regarding the impact of a solid foundation, teacher competency, and learner support on interest in learning geometry. Thematic or content analysis will identify patterns, themes, and qualitative insights from the gathered data.

Integration of Results

The findings from the quantitative and qualitative phases were triangulated to provide a more holistic understanding of the research questions. The mixed-methods approach allows for a deeper exploration of the phenomenon, providing both statistical evidence of relationships and a rich narrative of the experiences and perspectives of individuals involved.

Population

This study's accessible population was 420 mathematics learners (Grade 10 = 231; Grade 11 = 189) and 15 grade 10 and 11 mathematics teachers in the circuit of seven high schools.

Sample

The study employed a systematic sampling technique to select 60 learners (20 from each of the selected schools in the circuit, (Grade 10= 26 and Grade 11= 34). The following formula was used:

Learners' population: 420

Desired total sample size: (n) = 60

Sampling interval (k): $k=N/n$

$=420/60$

$= 7$

The random starting point per school was learner number 2; then the selection was done after every 7 learners.

Purposive sampling was used to select ten teachers from the cohort of 15. Purposive sampling is a deliberate look for participants with the desired qualities who appear to represent the target learners (Alvi, 2016).

Data analysis

The Chi-squared statistical analysis was employed to examine the relationships and predictive power of the identified variables on learners' interest in geometry.

FINDINGS AND DISCUSSION

Table 1. Shows a chi-squared test analysis to see if there is a relationship between a solid foundation of geometry and a learner interested in solving geometry problems.

A Learner Interested in Solving Geometry Problems	**A Solid Foundation of Geometry**				
	Agree	**Disagree**	**Strongly Agree**	**Strongly Disagree**	**Total**
Agree	4	11	2	1	18
	22.22	61.11	11.11	5.56	100.00
Disagree	2	27	3	1	33
	6.06	81.82	9.09	3.03	100.00
Strongly Agree	4	0	0	0	4
	100.00	0.00	0.00	0.00	100.00
Strongly Disagree	0	1	2	0	3
	0.00	33.33	66.67	0.00	100.00
Strongly Agree	1	0	0	0	1
	100.00	0.00	0.00	0.00	100.00
Strongly Disagree	0	1	0	0	1
	0.00	100.00	0.00	0.00	100.00
Total	**11**	**40**	**7**	**2**	**60**
	18.33	**66.67**	**11.67**	**3.33**	**100.00**

Note: Pearson chi-squared = 36.2488; p-value = 0.002

The results in Table 1 show that the p-value = 0.002 since $p < 0.05$, therefore, the null hypothesis:

H_0: There is no significant relationship between solid foundation of geometry and a learner being interested in solving geometry problems, is rejected.

The rejection of the null hypothesis suggests that evidence supports the idea that a solid foundation of geometry influences a learner's interest in solving geometry problems. This finding underscores the importance of having a solid grasp of the fundamental concepts in geometry for fostering interest and engagement in the subject matter.

These results have important implications for educators and curriculum developers. The results highlight the critical role of building a solid foundation in geometry within the educational framework. Educators may need to focus on ensuring that learners thoroughly understand basic geometric principles and concepts to enhance their interest and motivation in tackling more complex geometry problems.

A solid foundation in geometry is essential for immediate problem-solving and long-term academic success in related fields such as mathematics, engineering, and sciences. Learners who are interested in geometry are more likely to continue studying and excelling in mathematics, which can open various career opportunities in Science, Technology, Engineering, and Mathematics (STEM) fields.

The rejection of the null hypothesis provides a clear answer to the research question regarding the relationship between a solid foundation of geometry and learner interest in solving geometry problems. It confirms that there is indeed a significant relationship between these variables, which supports the initial hypothesis.

The research study by Guner (2020) agrees with these findings in that learners who are not in the habit of

regularly studying geometry fail because of their limited background knowledge of geometry. These findings support Adolphus' (2011) findings, which revealed that learners become less interested in solving geometry problems when their foundation in geometry is poor, while when learners' foundational knowledge is solid, they get more interested and motivated to solve more geometry problems in their daily lives.

Table 2. Shows A Chi-Squared Test Analysis to See If There Is a Relationship Between A Teacher's Competence In Geometry And Learners' Interest In Learning Geometry

Learners Interested in Geometry	**Teacher's Competence in Geometry**				
	Agree	**Disagree**	**Strongly agree**	**Strongly disagree**	**Total**
Agree	6	2	10	0	18
	33.33	11.11	55.56	0.00	100.00
Disagree	18	3	11	1	33
	54.55	9.09	33.33	3.03	100.00
Strongly Agree	1	0	3	0	4
	25.00	0.00	75.00	0.00	100.00
Strongly Disagree	2	0	1	0	3
	66.67	0.00	33.33	0.00	100.00
Strongly Agree	0	0	1	0	1
	0.00	0.00	100.00	0.00	100.00
Strongly Disagree	1	0	0	0	1
	100.00	0.00	0.00	0.00	100.00
Total	**28**	**5**	**26**	**1**	**60**
	46.67	**8.33**	**43.33**	**1.67**	**100.00**

Note: Pearson chi-squared = 8.1692; p-value = 0.917

Table 2 shows that the p-value=8.1692, since $p > 0.05$, therefore, the null hypothesis:

H_0: There is no significant relationship between a teacher's competency in geometry and learners' interest in geometry, which is accepted.

The research study findings elicit that there is no significant relationship between teacher's competence in geometry and learners' interest in learning geometry, but this contradicts the findings of other researchers like Fauth (2019), who found that teacher competence, such as pedagogical content knowledge and teaching enthusiasm is positively related to learners' interest in geometry learning.

The findings revealed that despite the hypothesis being accepted, nuances and implications exist. While teacher competency in geometry may not directly correlate with learners' interest in the subject, several factors could influence this relationship.

One possible interpretation of the results is that while teacher competency is undoubtedly vital in facilitating compelling learning experiences, learners' interest in a subject is influenced by many factors beyond just the teacher's skills. These factors may include the teaching methods employed, the relevance of the subject matter to learners' lives, the classroom environment, and individual learner preferences and learning styles.

Furthermore, it's essential to acknowledge the limitations of this

study. The scope may not have accounted for all possible variables that could impact learners' interest in geometry. Additionally, the methodology used to measure teacher competency and learner interest may have inherent biases or limitations.

Despite these limitations, the findings provide valuable insights for educators and policymakers. They highlight the complexity of fostering interest in mathematics subjects like geometry and underscore the need for a multifaceted approach that considers teacher competency and other contextual and individual factors.
Future research could explore additional variables that may influence learners' interest in geometry and further investigate the interplay between teacher competency and learner engagement. Educators can develop more effective strategies to promote interest and proficiency in geometry and other mathematics by understanding these dynamics more deeply.

Table 3 Illustrates A Chi-Squared Test Analysis If There Is a Relationship Between Support Given to The Learner on Solving Geometry and A Learner Interested In Learning Geometry

A Learner Interested in Learning Geometry	**The Support Given to Learners When Solving Geometry**				
	Agree	**Disagree**	**Strongly Agree**	**Strongly Disagree**	**Total**
Agree	4 22.22	4 22.22	0 0.00	10 55.56	18 100.00
Disagree	3 9.09	22 66.67	0 0.00	8 24.24	33 100.00
Strongly Agree	0 0.00	3 75.00	0 0.00	1 25.00	4 100.00
Strongly Disagree	0 0.00	0 0.00	1 33.33	2 66.67	3 100.00
Strongly Agree	1 100.00	0 0.00	0 0.00	0 0.00	1 100.00
Strongly Disagree	0 0.00	0 0.00	0 0.00	1 100.00	1 100.00
Total	**8** **13.33**	**29** **48.33**	**1** **1.67**	**22** **36.67**	**60** **100.00**

Note: Pearson chi-squared = 40.5374; p-value = 0.000

It is understood from Table 4.6 that after the chi-squared analysis the p-value=0.000, since $p < 0.05$, therefore, the stated null hypothesis:

H_0: There is no significant relationship between support given to the learners on solving geometry and learners being interested in learning geometry rejected. On the other note, learners responded on the matter, for example, T6 said:

> *In our days, we are struggling to get textbooks for teaching and learning geometry. Other support material such as teaching aids is something else, there is absolutely nothing provided for teachers as support material to make this geometry easy.*

This finding suggests that the level of support given to learners directly influences their engagement and enthusiasm towards the subject matter. The struggle to obtain textbooks

and teaching aids for geometry affects teaching and learning in multiple ways:

- Social Cognitive Theory suggests that the lack of resources can reduce teachers' self-efficacy and limit modelling and observational learning opportunities.
- Self-determination theory indicates that inadequate resources can undermine teachers' autonomy, competence, and sense of relatedness, impacting their motivation and effectiveness.
- Conceptual Change Model theory highlights how the absence of resources can create cognitive conflict and hinder the process of accommodating new teaching methods, affecting teachers' and students' understanding of geometry.

This implies that the support offered to learners plays a crucial role in shaping their attitude towards learning geometry. This could encompass various factors, such as the quality of teaching materials, the effectiveness of instructional methods, and the availability of assistance when learners encounter difficulties. By recognising the importance of support, educators can tailor their approaches to meet learners' needs and interests better.

These results underscore the significance of incorporating supportive measures in geometry teaching. Learners receiving adequate support are likelier to develop a positive attitude towards the subject, leading to enhanced learning outcomes. This aligns with the broader goal of fostering intrinsic motivation and curiosity among learners, ultimately contributing to their academic success. This was revealed in the study conducted by Mamali (2015), who found that there is a need for support, for example, parental and teacher support and extra classes on solving geometry to enhance learners' positive attitude towards learning geometry. Learner support instils motivation and love for the subject.

These findings hold significant implications for educators and policymakers involved in curriculum development and instructional practices. By emphasising the importance of support mechanisms, educational institutions can design interventions to improve learner engagement and achievement in geometry. Moreover, recognising the link between support and interest in learning can inform strategies for promoting STEM education, where geometry is a foundational component.

The rejection of the null hypothesis reaffirms the research question's inquiry into the relationship between support provided to learners in solving geometry problems and their interest in learning geometry. The findings validate the hypothesis that increased support correlates with heightened learner interest, highlighting the interconnectedness between pedagogical support and learner engagement in the context of geometry education.

CONCLUSION

In conclusion, the results indicate that a strong foundation in geometry and adequate support for learners significantly enhance learners' interest in solving geometry problems. This implies that the quality of geometry instruction and the level of support provided can influence engagement and motivation, ultimately affecting learners' outcomes in geometry. The implications of these results may include the following: refocus of the curriculum, changed educational methods, the establishment of support

structures and policy recommendations; the details are given below:

Curriculum development

The curriculum must focus on developing foundational skills by ensuring that learners are well-developed with the basic geometric skills required for learning geometry. This can be possible by developing a curriculum that emphasises core geometric concepts, like shapes, angles, area, volume) early on, ensuring learners build a strong base before tackling more complicated topics like proofs and theorems.

The curriculum must emphasise interdisciplinary projects where geometry is connected to real-life scenarios, such as geometry in art (e.g., tessellations) or in nature (e.g., symmetry in plants), making the subject more relatable and engaging to the learners. The curriculum must emphasise Project-Based Learning, where learners can design a park or a small building, applying geometric principles in a practical context, thus fostering a more profound understanding and interest.

Educational methods

Teachers must use personalised learning, for example, assessments, to identify individual learners' strengths and weaknesses in geometry, allowing teachers to tailor instruction and provide targeted support, such as small group tutoring or differentiated assignments. The teaching must change from rote learning to active learning techniques incorporating hands-on activities, such as geometric manipulatives or software like GeoGebra, to allow students to explore and visualise geometric concepts to promote active engagement. Teachers must create a collaborative learning environment by facilitating group work where learners tackle geometry problems as a team, encouraging discussion and peer support, enhancing understanding and fostering a sense of community in learning.

Support structures

There is a need to establish mentorship initiatives pairing gifted students with slow learners to support them in geometry, fostering a culture of collaboration and reinforcement. There is a need to provide professional development for teachers focused on effective geometry instruction strategies, such as inquiry-based learning and technology integration in teaching geometry.

Policy Recommendations

There is a need for even resource distribution among the schools. Schools must advocate for funding to acquire educational materials and technology that enhance geometry instruction, such as software licenses, manipulatives, and teacher training workshops.

The results advocate for curricular standards revisions, and policymakers are encouraged to review and update mathematics standards to focus on geometric conceptual understanding across grade levels, ensuring it's integrated throughout the mathematics curriculum from primary school to institutions of higher learning.

There is a need for assessment innovations in which the assessments measure computational skills, problem-solving abilities, and conceptual understanding in geometry, promoting a more comprehensive evaluation of learner progress.

By integrating these strategies, educational institutions can create a more engaging and supportive environment for geometry learning, leading to increased student interest and improved outcomes in mathematics overall.

RECOMMENDATIONS

As this study revealed that a solid foundation has a significant positive impact on learners' interest in learning geometry, to strengthen a solid foundation, the following are recommended:

- Mathematics teachers must implement or enhance educational programs focusing on building a solid foundation in geometry concepts. For example, revising of the curriculum, providing additional resources, or improving teaching methodologies to ensure a thorough understanding of fundamental geometric principles.
- Since the results of the study have also shown that learner support contributes significantly to learners' interest in learning geometry, it is recommended to have initiatives to improve support mechanisms, for example, creating mentoring programs, offering additional tutoring or assistance, providing resources for self-directed learning, or fostering a supportive learning environment.
- Implement continuous assessment strategies to monitor learners' progress and provide timely feedback. This can help identify areas where additional support is needed and allow timely intervention to maintain and enhance learners' interest in learning geometry.
- To enhance a solid foundation and learner support, integrate technology, for example, interactive online resources, educational apps, or virtual learning platforms, which are practical tools to reinforce geometric concepts and provide ongoing support to learners.

Contribution to Scholarship

The study explored the combined effects of the solid foundation and learner support on learners' interest in geometry. The research findings support a significant relationship between these factors and learners' interest in geometry. As a result, the paper makes several contributions to scholarship:

Theoretical Contribution

The paper contributes to the theoretical understanding of factors influencing learners' interest in geometry. It also contributes to educational psychology by shedding light on the interplay between foundational knowledge and learner support in shaping academic interests.

Practical Implications

The paper has practical implications for educators, curriculum developers, and policymakers. Understanding the importance of a solid foundation and learner support in enhancing interest may inform instructional strategies and support systems in geometry education. It also suggests specific interventions or changes in teaching methods that can be implemented to improve learners' interest in geometry.

Educational Policy and Planning

Policymakers may use the findings to inform decisions related to educational policies and resource allocation, particularly in the context of geometry education. The paper may advocate for integrating solid foundation-building and effective learner-support mechanisms into educational policies to improve overall interest and performance in geometry.

Contribution to Educational Research

The paper contributes to the broader body of educational research by adding to the knowledge base on effective educational practices and their impact on learner outcomes. In addition, it

might inspire further research on similar topics or encourage scholars to explore the combined effects of different factors in diverse educational contexts.

Professional Development

Educators and educational professionals may find insights in the paper that can be used to guide their professional development efforts. For instance, they may better understand how to tailor their teaching approaches to foster learners' interest in geometry.

STUDY LIMITATIONS

Of the three hypotheses, one null was accepted because of the p-value >0.05, H_0: There is no significant relationship between teacher's competence in geometry and learners' interest in geometry. The results might have been affected by the following:

Sample Size: The study used a sample size of 60 learners, which might be slight to capture the full range of variability in teacher competence and learner interest, potentially limiting the generalizability of the findings to a broader population.

Contextual Factors: the study might not have accounted for all possible contextual factors that could influence the relationship between teacher competence and learner interest in geometry. For example, school environment, teaching methods, or learner backgrounds could play a role.

Self-Report Bias: The study relied on self-reported data from learners' responses that might be subject to biases. Some learners might not accurately represent their true feelings and perceptions.

Variable Complexity: The concept of "teacher competence" and "learner interest" is multifaceted and complex. This study might have focused on specific aspects, and other irrelevant dimensions that were not considered could exist.

External Validity: Other researchers must cautiously generalise the findings of this study to other settings or populations. This study focused on a specific demographic of learners, black Africans, and the rural geographic area of the Eastern Cape province of South Africa. Therefore, caution should be exercised in extrapolating the results to different contexts. The null hypothesis accepted in this study can be rejected in a different setting.

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CONFLICT OF INTEREST

None of the researchers is conflicted about conducting this study. The study is not for gain but solely to disseminate information to the mathematics education community. in your chapter.

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APPENDIX A: INTERVIEW SCHEDULE FOR THE LEARNERS

1. What is your understanding of geometry?
2. Does the teacher give you resources to use in learning geometry?
3. Do you enjoy learning geometry?
4. What can be done to improve it?
5. What can be done to make learning of geometry enjoyable?
6. How are you performing in geometry?
7. Is there anything that can be done to improve your performance?

APPENDIX B: INTERVIEW SCHEDULE FOR THE TEACHER

1. What resources do you use when teaching geometry?
2. How do you ensure learners understand and enjoy geometry?
3. How is the performance of learners in geometry?
4. In your view what is the main problem that causes learners to have difficulty understanding and performing well in geometry?
5. What do you think can be done to solve this problem?