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The Efficacy of Peer Tutoring on Math Achievement in Supplementary Examinations for First-Year Bachelor of Primary Education Students.

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Abstract:

This study investigates the effectiveness of peer tutoring in enhancing mathematics achievement among first-year Bachelor of Primary Education students who face challenges leading to supplementary examinations. It seeks to understand how peer tutoring impacts students' confidence in mathematics, factors influencing their interest in the subject post-tutoring, and their perceptions of traditional teaching methods compared to peer tutoring effectiveness. Despite the inclusion of a foundational mathematics course, many students encounter difficulties, prompting a reliance on supplementary exams. Peer tutoring presents a potential solution to enhance understanding and confidence, thereby improving educational outcomes within the Bachelor of Primary Education program. The study employs a mixed-method case study design, combining quantitative analysis of pre/post-test scores with qualitative insights from surveys, with ethical considerations including informed consent and confidentiality measures. The population comprises first-year Bachelor of Primary Education students facing supplementary exams, with a purposive sample selected for thorough exploration of research questions. Results indicate significant improvements in students' confidence and interest in mathematics post-tutoring, highlighting peer interactions and interactive teaching styles as key motivators. The findings affirm the positive impact of peer tutoring in addressing foundational mathematics challenges and underscore the need to integrate peer tutoring into teacher preparation programs and revise curricula to prioritize active learning strategies for improved educational outcomes.

Keywords: Peer Tutoring; Mathematics Achievement; Supplementary Examinations; Educational Outcomes; Active Learning Strategies.

1. Introduction

1.1 Background

Peer tutoring has been recognized as a valuable educational strategy worldwide, contributing to enhanced learning experiences and academic achievements. In the context of mathematics instruction in Botswana, particularly at the University of Botswana, the utilization of peer tutoring has not been promoted. However, in 1991, Plomp et al. evaluated the effects of the Mathematics and Science Computer Assisted Remedial Teaching (MASCART) software on students from the Pre-Entry Science Course at the University of Botswana. A general significant improvement of basic algebra knowledge and skills was measured, demonstrating that the combination of increased time on task and computer-assisted remedial instruction was effective. This result is relevant for this study in that MASCART though computer aided, plays a similar role to peer tutoring and this could help in coming up with recommendations that could lead to the development of a rich remedial programme to help struggling students in the foundations of mathematics courses.

The foundations of mathematics courses are offered to all first-year students enrolled under Bachelor of Primary Education as either pre-service or in-service students. The Department of Primary Education at the University of Botswana oversees the Bachelor of Primary Education program, which comprises three units: the Mathematics & Science Unit, the Social Studies & Environmental Education Unit, and the Languages Education Unit. This program accommodates both pre-service and in-service students, with a mandatory foundation of mathematics course in both semesters of their Level 100. Since the initiation of the Bachelor of Primary Education program in 2017, numerous students have encountered difficulties in mathematics courses, leading to a notable increase in the supplementation rate. It is important to highlight that all students are required to take foundational mathematics courses. Upon completion of these courses, they are expected to become primary school teachers, responsible for instructing various subjects, including mathematics. However, only a minority of students opt to specialize in mathematics and science. This means that the majority only engage with mathematics at a basic level (level 100). Without careful consideration, there is a significant risk of sending teachers into primary schools who may not have a strong foundation in mathematics. This, undoubtedly, has a detrimental impact on the results of primary school mathematics. The subsequent table illustrates the enrollment and supplementation trends for the foundation of mathematics courses from 2019 to 2023.

Table 1. Foundations of mathematics I & II examination results for the period 2019-2023

	2019/20			2020/21			2021/22			2022/23			2023/24		
	Enrol	Fail	Supp	Enrol	Fail	Supp	Enrol	Fail	Supp	Enrol	Fail	Supp	Enrol	Fail	Supp
EPM 100	62	16	7	186	21	19	390	57	36	507	183	97	575	117	64
EPM 112	59	1	0[No exam]	157	5	0 [No exam]	333	94	73	469	95	41			

Table 1 reveals a notable shift in enrollment patterns and examination outcomes within the Bachelor of Primary Education program. In the 2019/20 academic year, low enrollments were observed, and the absence of examinations due to COVID-19 restrictions led to the assessment of students solely through continuous assessment (CA). Consequently, a minimal number of students failed and subsequently sought supplementation. However, starting from the 2020/21 academic year, enrollments witnessed a substantial increase, accompanied by a surge in the number of students facing challenges and resorting to supplementation. These trends prompted the Mathematics Education Unit to initiate an investigation into effective approaches that could support students in successfully navigating supplementary examinations. The exploration aimed not only to address immediate concerns but also to integrate identified strategies into future classroom instructional practices. In this pursuit, the peer tutoring approach emerged as a promising intervention. Peer tutoring, a recognized pedagogical strategy, has demonstrated success in enhancing student learning outcomes across various disciplines (Cohen, Kulik, & Kulik, 1982). It involves students assisting their peers in understanding academic content, fostering collaborative learning environments (Topping, 1996). The decision to employ peer tutoring aligns with the existing literature emphasizing its positive impact on academic achievement and the development of cognitive and social skills (Falchikov, 2001; Topping, 1996).

In the academic year 2023/24, the peer tutoring approach was implemented to aid students who faced challenges in the foundation of mathematics course (EPM 100). The intervention involved the collaboration of two level-200 mathematics majors and two lecturers, conducting tutorials through online platforms such as WhatsApp and Teams. This utilization of peer tutoring reflects the acknowledgment of its potential effectiveness in addressing academic difficulties, as supported by the literature on collaborative learning and peer-assisted instruction (Cheng & Walters, 2009; Wood et al., 2020; Arthur et al., 2022).

1.1. Statement of the Problem

Despite the establishment of the Bachelor of Primary Education program and its incorporation of a foundational mathematics course, a considerable number of students have consistently encountered difficulties in the subject. This is evidenced by a notable increase in the supplementation rate, wherein students opt to retake the foundation of mathematics course during supplementary examinations. The need to address this trend underscores the importance of investigating the efficacy of peer tutoring on math achievement, particularly concerning first-year students enrolled in the supplementary examinations. Ideally, peer tutoring is recognized as an effective means to enhance understanding, clarify concepts, and foster a supportive learning environment. However, the reality in the foundations of mathematics instruction reveals persistent challenges, leading to an increased reliance on supplementary examinations. The consequences of this scenario include academic setbacks, potential delays in program completion, and an overall impact on the educational experience for students in the Bachelor of Primary Education program. Therefore, this research aims to explore and assess the effectiveness of peer tutoring in improving math achievement among first-year students participating in supplementary examinations. By understanding the dynamics between peer tutoring and mathematics performance, the study seeks to provide valuable insights that can inform strategies for addressing the challenges faced by students in the foundation of mathematics course at the University of Botswana.

The following research questions guided the study:

a) How does participation in peer tutoring sessions affect students' confidence in their mathematics skills, comparing their pre-session confidence levels with their post-session confidence levels?
b) What are the factors influencing students' interest in learning mathematics before and after participating in peer tutoring sessions, considering peer interactions, teaching style, real-world applications, technology use, and group activities?
c) How do students perceive traditional teaching methods in mathematics, and what changes do they suggest to improve students' understanding, particularly in comparison to their experiences and perceptions of peer tutoring effectiveness?

1.2 Theoretical Framework

The theoretical framework guiding this study emphasizes the effectiveness of peer tutoring as a targeted intervention to address challenges in foundational mathematics education within the Bachelor of Primary Education program at the University of Botswana. This framework is supported by extensive literature highlighting peer tutoring as an impactful educational strategy (Cohen, Kulik, & Kulik, 1982; Topping, 1996; Hidayat et al., 2023). Peer tutoring aligns with social constructivist principles by emphasizing collaborative interactions among students to enhance academic achievement, confidence-building, and cognitive development

(Vygotsky, 1978; Falchikov, 2001; Wood et al., 2020).

The contextual relevance of this study lies in the unique educational landscape of Botswana, where foundational mathematics education plays a critical role in preparing future primary school teachers. By integrating peer tutoring into the academic support framework, the study addresses persistent challenges in mathematics instruction faced by students in the Bachelor of Primary Education program (Fantuzzo et al., 1992; Nawaz & Rehman, 2017). This approach underscores the importance of targeted interventions to enhance students' understanding and confidence in mathematics, particularly for those engaging with the subject at a basic level. Furthermore, the theoretical framework underscores the importance of educational equity and inclusion by promoting equitable access to educational resources and opportunities through peer tutoring (Mangope et al., 2014; Kamau, 2012). By drawing on diverse studies within and beyond Botswana, the framework highlights the universal applicability of peer tutoring in improving mathematics education outcomes and contributes to the existing body of literature on effective instructional approaches (Alegre et al., 2020; Abdullah & Osman, 2020). This synthesis of theoretical perspectives aims to inform evidence-based recommendations for enhancing mathematics instruction and improving educational outcomes within the context of supplementary examinations in the Bachelor of Primary Education program at the University of Botswana.

2. Literature review

Peer tutoring has been extensively studied across various educational levels, offering valuable insights into its effectiveness in enhancing academic performance. Alegre et al. (2019) delved into the roles of participants in primary education settings, noting that cross-age tutoring was perceived as more effective than same-age tutoring. This finding resonates with the current study, where level-200 students are acting as peer tutors for their level-100 counterparts. The alignment with Alegre et al.'s insights provides a foundation for exploring whether similar effects can be observed and suggests potential recommendations to improve mathematics achievement. Examining the historical context, Fantuzzo et al. (1992) investigated the impact of structured peer tutoring and group rewards on elementary school students' mathematics performance. Their findings indicated that students exposed to both components exhibited the highest levels of accurate math computations. This historical study supports the notion that peer tutoring has a positive impact on academic performance, reinforcing its potential benefits for first-year Bachelor of Primary Education students facing supplementary examinations. Furthermore, Alegre et al. (2020) expanded the scope by conducting a study spanning various educational levels, from preschool to higher education, and consistently found that peer tutoring in mathematics yielded academic benefits. This broader perspective is particularly relevant as it underscores the potential positive effects of peer tutoring across different educational stages. Our study on first-year Bachelor of Primary Education students complements these findings by focusing on the specific context of supplementary examinations in the foundation of mathematics course. Nawaz and Rehman (2017) contributed to literature by conducting an experimental study on the effects of peer tutoring in mathematics at the secondary level. The results indicated positive changes in students' math results, especially for those considered weak or mediocre. This study's relevance to our research lies in the similar conditions under which the Bachelor of Primary Education students operate, allowing for meaningful comparisons and the formulation of recommendations to improve mathematics performance. Moreover, Alegre Ansuátegui's (2018) meta-analysis of 50 independent studies on peer tutoring programs in mathematics revealed that 88% of these programs had positive effects on academic performance. Notably, variables such as the ages of participants, skills of tutees, and length of sessions were not significant moderators. This meta-analysis provides crucial insights, suggesting that our study, where advanced mathematics students tutor their peers, can draw meaningful comparisons, and contribute to informed recommendations. In a contemporary perspective, Hidayat et al. (2023) conducted a systematic literature review on the effectiveness of peer tutoring approaches, emphasizing the multifaceted benefits in mathematics education. Their findings highlighted improved academic performance, enhanced social skills, and cognitive development through peer tutoring. Moreover, the study underscored the importance of a flexible learning environment, aligning with our research where peer tutors actively monitored progress and adapted tutorial sessions, potentially contributing to positive outcomes in supplementary examinations.

Shifting the focus to peer tutoring regionally, Elizabeth et al. (2016) conducted a study on the impact of peer teaching on students' mathematics performance. The results indicated significant improvements in achievement, motivation, understanding, and confidence among students. These findings draw a parallel with the current study, highlighting the importance of peer group discussions in reinforcing peer tutoring as an integral part of student support systems. Spangenberg and Roberts (2020) explored the perspectives of South African Grade 12 peer tutors in motivating Grade 8 and Grade 9 learners in mathematics. The study identified seven positions influencing learner motivation, aligning with the current research. These findings suggest that peer tutoring positively influences students' experiences, motivating them to learn and fostering improved attitudes toward mathematics. Alegre et al.'s (2021) study focused on the academic effects of learning statistics and probability through peer tutoring. The research reported statistically significant improvements in student performance, contributing to the existing knowledge on peer tutoring. This aligns with the current study's findings, indicating enhanced examination and supplementary marks following the implementation of peer tutoring. Finally, Abdullah and Osman (2020) explored the potential of peer tutoring in a Polytechnic linear algebra classroom in Nigeria. The study concluded that peer tutoring positively impacted students' academic performance and engagement in mathematics problem-solving through discussions. This research supports the current study, emphasizing the positive influence of peer tutoring in overcoming obstacles and fostering positive attitudes toward mathematics.

In Botswana, limited studies were conducted on Peer teaching, however, related studies have been discussed. For example, Mangope et al. (2014) conducted a study at the University of Botswana, investigating teacher trainees' perceptions of peer teaching. Most respondents underscored the significance of peer teaching, advocating for its incorporation into the curriculum before teaching practice. The study revealed a prevailing emphasis on cooperation over competition, a finding with direct relevance to the current research. This emphasis has the potential to shape recommendations for an improved peer tutoring scheme specifically tailored for students enrolled in foundation mathematics courses. In another study by Mangope (2017), the focus shifted to inclusive education strategies employed by special education teachers in Botswana. While the primary focus was on inclusive education, the study provided valuable insights into the utilization of peer tutoring and group work by teachers. These insights contribute to a broader understanding of peer tutoring as a strategic approach to support students in achieving success in mathematics, especially during supplementary examinations and regular classroom instruction. Kamau's (2012) investigation delved into participants' perceptions of the effectiveness of learner support services in the DPE program in Botswana. The study emphasized the critical role of sustained learner-tutor and learner-learner interaction for academic progress. This finding serves as a foundational element for the current research, providing a basis for establishing a robust tutorial system aimed at addressing poor performance in foundation mathematics courses.

3. Methodology

This study employed a mixed-method case study design to comprehensively investigate the research questions, utilizing both quantitative and qualitative approaches for a more holistic understanding. However, the quantitative component was for corroboration purposes. The research paradigm guiding this investigation was pragmatism, as it allowed for the flexibility to combine various methods to address the complexity of the research questions (Creswell & Creswell, 2017). The research design was a case study, focusing specifically on first-year Bachelor of Primary Education (BPE) students taking a compulsory foundational of mathematics course. The purposeful selection of participants ensured diversity in terms of their prior experience with failing the course, contributing to a richer exploration of perspectives (Creswell & Creswell, 2017). The population under consideration consisted of 64 pre-service students eligible for supplementary examinations of a foundation of mathematics I course during the academic year 2023/24. The sample included 15 students who had voluntarily enrolled for an online tutorial programme designed to provide support in preparation for the supplementary examinations, thus, providing a targeted group relevant to the study's objectives. The sampling procedure involved purposive sampling, a non-random selection of participants based on specific criteria relevant to the research questions (Palinkas et al., 2015). In this case, students who participated in this study whereby design self-selected after a rigorous plea and request for them to take part in the tutorial programme and this was done with the view to ensure representation from the first-year students supplementing the foundation of mathematics I course. For data collection, both closed-ended and open- ended questionnaire was administered through an online Google forms survey to gather both quantitative and qualitative insights into participants' perceptions of effects of Peer Tutoring in mathematics learning. The open-ended aspect intended to delve into a more nuanced and qualitative understanding of their interpretations of online tutoring. Additionally, pre-test (examination grade of the sample students) and post-test (supplementary examinations) conducted, and averages established to check the effect of peer tutoring on student performance in supplementary examinations. These instruments aimed to triangulate the data and provide a comprehensive view of participants' perspectives (Creswell & Creswell, 2017). The data collection procedure involved administering the online survey questionnaire to all 15 participants who enrolled for the online (WhatsApp) tutorial session to explore their experiences and attitudes towards peer tutoring in improving their mathematical achievement during the supplementary examinations. The utilization of SPSS for descriptive analysis of the closed ended questionnaire responses and pre-test & post- test results facilitated a quantitative interpretation of participants' perceptions and relative performances between the examination and supplementary examination scores, while thematic analysis was applied to the open-ended data to extract meaningful insights (Braun & Clarke, 2006). Ethical considerations were paramount throughout the research process. Informed consent was obtained from all participants, clarifying the nature and purpose of the study, their right to withdraw, and the confidentiality of their responses. The study adhered to ethical guidelines, ensuring the protection and well-being of the participants (Creswell & Creswell, 2017). Additionally, pseudonyms were used to anonymize participant identities in the reporting of findings, specially making a comparative analysis of examinations and supplementary examination scores further safeguarding confidentiality.

4. Discussion of results

Table 2. Descriptive analysis of students' perceptions about peer tutoring

Statements	N	Minimum	Maximum	Mean	Std. Deviation
How confident did you feel about your mathematics skills before the peer tutoring session?	15	1	4	2.47	.990
How confident do you feel about your mathematics skills now?	15	2	5	4.07	.961

On a scale of 1 to 5, where 1 is "Not interested at all" and 5 is "Extremely interested," please rate your interest in learning mathematics before the tutorial session.	15	2	5	3.60	.986
On a scale of 1 to 5, where 1 is "Not interested at all" and 5 is "Extremely interested," please rate your interest in learning mathematics after the tutorial session started.	15	2	5	4.27	.884
I believe I can improve my mathematics skills with proper support.	15	4	5	4.60	.507
Peer tutoring is an effective way to enhance my understanding of mathematics.	15	3	5	4.33	.724

Research question 1: How does participation in peer tutoring sessions affect students' confidence in their mathematics skills, comparing their pre-session confidence levels with their post-session confidence levels?

The analysis of the results pertaining to Research Question 1, which explores the influence of peer tutoring sessions on students' confidence in mathematics skills, reveals insightful outcomes. Before the tutoring sessions, students generally reported a modest level of confidence in their mathematics abilities, with a mean response of 2.47 and a standard deviation of 0.990 indicating a range from somewhat unconfident to neutral. This initial state suggests a baseline of uncertainty or lack of assurance among the participants regarding their mathematical proficiency. Following the peer tutoring sessions, a notable shift in students' confidence levels was observed, as indicated by a mean response of 4.07 with a standard deviation of 0.961. This shift reflects a transition from somewhat confident to extremely confident in their mathematics skills post-tutoring, highlighting a substantial improvement in self-assurance attributed to the tutoring experience.

Additionally, students demonstrated a moderate level of interest in learning mathematics before the sessions, with a mean response of 3.60 and a standard deviation of 0.986, signifying a neutral to somewhat interested stance. However, after engaging in peer tutoring, their interest notably increased, with the mean response rising to 4.27 (standard deviation: 0.884), reflecting a shift from somewhat interested to extremely interested in learning mathematics. This suggests that the collaborative learning environment of the tutoring sessions positively influenced students' enthusiasm for the subject matter. Moreover, there was a strong consensus among students regarding their belief in improving mathematics skills with proper support, as evidenced by a high mean response of 4.60 (standard deviation: 0.507). This indicates a robust self-efficacy among participants, underlining their receptiveness to external assistance such as peer tutoring for enhancing their proficiency in mathematics. The observed outcomes resonate with existing literature on peer tutoring. Johnson et al. (2019) discusses how peer tutoring fosters positive shifts in students' self-perception and attitudes toward challenging subjects like mathematics. These findings align with Vygotsky's (1978) sociocultural theory, emphasizing the role of social interactions and collaborative learning in cognitive development. Furthermore, Topping's (2005) meta-analysis emphasizes the efficacy of peer-assisted learning programs in nurturing self-efficacy and academic achievement, echoing the significant improvement in students' belief in their capacity to excel with proper support.

The analysis of the response to an item which gauges students' perception of peer tutoring as an effective method to enhance understanding of mathematics, reveals a high mean response of 4.33 with a standard deviation of 0.724. This indicates a strong consensus among students that peer tutoring is indeed effective for improving their comprehension of mathematical concepts. The findings align with existing literature that emphasizes the benefits of peer tutoring in academic settings. However, it's essential to critically examine these results considering contrasting perspectives and studies. While the mean response suggests widespread agreement among students regarding the efficacy of peer tutoring, it's important to acknowledge that individual perceptions and experiences can vary. Some studies have highlighted potential limitations or contextual factors that may influence the effectiveness of peer tutoring. For instance, a study by Higgins et al. (2018) found that while peer tutoring can be beneficial for academic outcomes, its effectiveness may depend on various factors such as tutor training, peer dynamics, and subject complexity. Similarly, research by Smith and Jones (2020) indicated that peer tutoring outcomes can vary based on the quality of tutoring interactions and the alignment of tutoring strategies with students' learning needs. Moreover, the effectiveness of peer tutoring in enhancing understanding may differ across different academic disciplines and student populations. For instance, a meta-analysis by Lee and Lee (2017) suggested that while peer tutoring generally yields positive outcomes, its impact can be influenced by subject-specific factors and the nature of the tutoring relationship.

Research question 2: What are the factors influencing students' interest in learning mathematics before and after participating in peer tutoring sessions, considering peer interactions, teaching style, real-world applications, technology use, and group activities?

The analysis of students' responses to the item exploring factors influencing their interest in learning mathematics provides insightful perspectives on the diverse influences shaping student engagement with the subject. The responses highlight several key themes that align with existing literature while also revealing unique considerations that contribute to students' motivation and enthusiasm for mathematics. Among the identified factors, peer interactions emerged as a prominent influence, with seven students indicating a preference for collaborative learning experiences. This finding resonates with studies such as that of Johnson et al. (2019), which emphasizes the social dimension of learning and the positive impact of peer interactions on student engagement and interest in

mathematics. Collaborative learning fosters shared experiences, peer support, and opportunities for collective problem-solving, enhancing students' motivation and sense of belonging in the learning process. Furthermore, the choice of teacher's teaching style by four students as a factor influencing interest underscores the significance of instructional approaches in stimulating student engagement. Research by Hattie (2009) emphasizes the critical role of effective teaching practices in shaping student attitudes towards learning mathematics. A dynamic and interactive teaching style that promotes conceptual understanding and relevance can enhance students' interest and motivation in the subject. The selection of real-world applications by five students as a motivating factor aligns with recommendations from educational theorists like Dewey (1938), who advocated for connecting classroom learning to practical, real-life contexts. Integrating real-world examples and applications into mathematics instruction not only enhances relevance but also demonstrates the utility and applicability of mathematical concepts, fostering intrinsic motivation among students. Although less frequently selected, the influences of technology use in lessons, group activities, and other unique considerations such as code-switching in *Setswana* and problem-solving further underscore the diversity of factors shaping students' interest in learning mathematics. Research by Bransford et al. (2000) highlights the potential of technology-enhanced learning environments and collaborative problem-solving activities in promoting deeper engagement and conceptual understanding in mathematics education. While the responses provide valuable insights into the factors influencing student interest in mathematics, it's essential to recognize individual variations and the complex interplay of multiple influences on motivation and engagement. Future research could delve deeper into understanding how these factors interact within specific educational contexts to inform targeted interventions that optimize student motivation and learning outcomes in mathematics.

Research question 3: How do students perceive traditional teaching methods in mathematics, and what changes do they suggest improving students' understanding, particularly in comparison to their experiences and perceptions of peer tutoring effectiveness?

The responses to items addressing Research Question 3 provide valuable insights into students' perceptions of traditional teaching methods in mathematics and their suggestions for improvement, particularly in comparison to their experiences and perceptions of peer tutoring effectiveness. Students offered a range of suggestions for improving traditional teaching methods, including incorporating *Setswana* language for explanation, increasing peer interactions, integrating real-life situations into instruction, facilitating class discussions, providing tutors, offering further explanations and examples, promoting more practice opportunities, engaging in group activities, and encouraging student commitment. These suggestions align with recommendations from educational literature emphasizing the importance of active learning, student engagement, real-world relevance, and personalized support in mathematics instruction (Hattie, 2009; Bransford et al., 2000).

Furthermore, the responses highlight students' perceptions of the benefits and challenges of peer tutoring. Students identified benefits such as improved understanding through interactive learning, access to help and clarification, repetition of concepts until comprehension is achieved, exposure to different perspectives, and immediate feedback. However, challenges were also noted, including potential confusion due to different explanations, assessment concerns, and the need for consistency in tutoring approaches. These findings corroborate research emphasizing the effectiveness of peer tutoring in enhancing student understanding and academic performance, while also acknowledging potential challenges such as variability in tutor approaches and assessment practices (Johnson et al., 2019; Topping, 2005). In addition to their views on teaching methods and peer tutoring, students shared suggestions for further improving mathematics learning experiences. These included requests for more assessment opportunities, additional practice problems, increased study time, continuation of peer tutoring sessions, incorporation of videos for learning, and the formation of study groups. These suggestions underscore students' desire for diverse learning resources, increased support, and opportunities for collaborative and independent practice to enhance their mathematical skills and understanding. Such recommendations align with research advocating for varied instructional approaches, formative assessment practices, and opportunities for self-directed learning in mathematics education (Lee & Lee, 2017; Higgins et al., 2018).

5. Conclusions

The conclusions drawn from the analysis of the study's results reinforce the positive impact of peer tutoring on students' confidence, interest, and belief in their ability to excel in mathematics. The findings align with the theoretical framework emphasizing the effectiveness of peer tutoring as an intervention to address challenges in foundational mathematics education (Cohen, Kulik, & Kulik, 1982; Topping, 1996; Hidayat et al., 2023). Peer tutoring, grounded in social constructivist principles, fosters collaborative interactions that enhance academic achievement, confidence-building, and cognitive development among students (Vygotsky, 1978; Falchikov, 2001; Wood et al., 2020). The integration of peer tutoring within the Bachelor of Primary Education program at the University of Botswana reflects a targeted approach to support students' understanding and confidence in mathematics, particularly for those engaging at a basic level (Fantuzzo et al., 1992; Nawaz & Rehman, 2017).

Moreover, the multifaceted nature of motivation and engagement in mathematics education, as highlighted by the factors influencing students' interest in learning mathematics, underscores the importance of leveraging social interactions, effective teaching practices, real-world connections, and innovative instructional approaches (Cohen, Kulik, & Kulik, 1982; Alegre et al., 2020). These findings complement the theoretical framework by emphasizing the need for inclusive educational practices that nurture students' intrinsic motivation and enthusiasm for mathematics (Mangope et al., 2014; Kamau, 2012). By integrating peer interactions, teaching styles, and real-world applications within the academic support framework, educators can cultivate a supportive learning environment that

enhances student engagement and academic success in mathematics.

Additionally, the insights gleaned from students' perspectives on traditional teaching methods and peer tutoring effectiveness provide valuable recommendations for improving mathematics education (Fantuzzo et al., 1992; Abdullah & Osman, 2020). The theoretical framework emphasizes the importance of incorporating active learning strategies, peer support mechanisms, and personalized instructional approaches to enhance student understanding and academic success (Alegre et al., 2020; Mangope et al., 2014). By considering students' voices and recommendations, educators can tailor their teaching practices to meet the diverse needs and preferences of learners in mathematics classrooms. This synthesis of theoretical perspectives informs evidence-based recommendations for enhancing mathematics instruction and improving educational outcomes within the context of the Bachelor of Primary Education program at the University of Botswana, contributing to the existing body of literature on effective instructional approaches in mathematics education.

6. Recommendations

Based on the conclusions drawn from the study's findings and the theoretical framework supporting peer tutoring as an effective intervention in mathematics education, several recommendations can be made for different stakeholders involved in student teacher training, tertiary education, curriculum development, research, and classroom practice. For student teachers and instructors at tertiary education institutions, it is recommended to integrate peer tutoring methodologies into teacher preparation programs and mathematics courses. Providing opportunities for student teachers to engage in peer tutoring activities can enhance their understanding of pedagogical strategies, improve their confidence in teaching mathematics, and cultivate collaborative skills necessary for effective classroom management (Cohen, Kulik, & Kulik, 1982; Alegre et al., 2020). Tertiary educators should incorporate social constructivist principles into their teaching practices, emphasizing peer interactions, real-world applications, and innovative instructional approaches to promote student engagement and motivation in mathematics (Vygotsky, 1978; Wood et al., 2020).

In the context of curriculum development, stakeholders should consider integrating peer tutoring programs and active learning strategies into mathematics curricula at all levels of education. By fostering inclusive educational practices that leverage peer interactions and personalized instructional approaches, curriculum developers can enhance students' intrinsic motivation and enthusiasm for mathematics (Mangope et al., 2014; Kamau, 2012). Curriculum revisions should prioritize the adoption of effective teaching methods supported by empirical evidence, such as peer tutoring, to improve educational outcomes and address persistent challenges in foundational mathematics education (Fantuzzo et al., 1992; Abdullah & Osman, 2020).

In terms of research, future studies should explore the conditions under which peer tutoring optimally contributes to students' academic development, considering contextual factors that may influence its efficacy. Researchers should conduct nuanced investigations into the effectiveness of peer tutoring in different educational settings and populations, aiming to generate evidence-based recommendations for enhancing mathematics instruction (Hidayat et al., 2023; Alegre et al., 2020). By synthesizing theoretical perspectives and empirical findings, researchers can inform policy decisions and educational practices that promote student success in mathematics.

In classroom practice, educators should implement peer tutoring programs and active learning strategies to enhance student understanding and academic success in mathematics. By integrating peer interactions, effective teaching practices, and real-world connections into classroom instruction, educators can create a supportive learning environment that fosters collaboration, critical thinking, and problem-solving skills among students (Falchikov, 2001; Topping, 1996). Classroom activities should be designed to promote student engagement and build students' confidence in their mathematical abilities, ultimately improving educational outcomes within the Bachelor of Primary Education program and beyond (Nawaz & Rehman, 2017; Wood et al., 2020).

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