"Empowering Students through Indigenous Knowledge: Benefits of Indigenizing Mathematics Education in Southern Province, Zambia"

Dr. Kaziya Kadonsi

Department Educational Psychology, Special Education, and Sociology of Education, University of Zambia

DOI: https://dx.doi.org/10.47772/IJRISS.2024.808080

Received: 17 July 2024; Accepted: 22 July 2024; Published: 31 August 2024

ABSTRACT

This study explores the benefits of indigenizing mathematics education in Southern Province, Zambia, by integrating indigenous knowledge into the mathematics curriculum. The research aims to assess the impact of this approach on student empowerment, engagement, and academic performance. Employing a sequential exploratory mixed-methods design, the study combines quantitative data from structured questionnaires administered to 55 mathematics teachers and 271 students with qualitative data from in-depth interviews and focus group discussions involving 15 teachers, 10 parents, 6 school administrators, and 1 educational official. Findings indicate that indigenized mathematics education significantly enhances student engagement, comprehension, and academic performance. It also fosters a sense of pride and cultural identity among students, strengthens school-community relationships, and promotes community involvement in education. Despite these positive outcomes, challenges such as the need for professional development, adequate resources, and institutional support were identified. This research underscores the importance of culturally relevant pedagogy and provides practical recommendations for policymakers, educators, and curriculum developers to make mathematics education more inclusive and effective. The study contributes to the academic discourse on culturally responsive teaching and highlights the potential of indigenized education to promote educational equity and excellence in Southern Province, Zambia.

Keywords: Indigenizing Education, Mathematics Education, Culturally Responsive Pedagogy, Indigenous Knowledge, Student Engagement, Academic Performance, Southern Province, Zambia, Educational Equity, Community Involvement, Professional Development

INTRODUCTION

Mathematics education has long been dominated by Western pedagogical approaches, often overlooking the rich cultural contexts and indigenous knowledge systems present in non-Western societies. In Southern Province, Zambia, the disconnect between traditional teaching methods and students' cultural backgrounds has contributed to challenges in mathematics learning and comprehension. This research article explores the potential benefits of integrating indigenous knowledge into the mathematics curriculum, a process referred to as indigenizing mathematics education.

Indigenizing education involves incorporating local cultural elements, values, and knowledge systems into the teaching and learning process. In the context of Southern Province, this means recognizing and utilizing the mathematical concepts embedded in the local practices, languages, and traditions of the Zambian people. By doing so, educators can create a more relevant and engaging learning experience for students, which can enhance their understanding and appreciation of mathematics. Previous studies have shown that culturally

responsive teaching can improve student engagement, retention, and academic performance. However, there is a paucity of research specifically addressing the indigenization of mathematics education in Zambia. This study aims to fill this gap by examining how integrating indigenous knowledge can empower students, foster a deeper connection to their cultural heritage, and improve their overall academic outcomes.

The primary objectives of this research were to investigate the impact of indigenized mathematics education on student engagement and performance, to identify the specific elements of indigenous knowledge that can be effectively incorporated into the mathematics curriculum, and to provide practical recommendations for educators and policymakers. Through a combination of qualitative and quantitative methods, this study explored the perceptions and experiences of students, teachers, and community members regarding the indigenization of mathematics education.

In addition to contributing to the academic discourse on culturally responsive teaching, this research holds significant implications for educational practice in Zambia and other regions with diverse cultural landscapes. By highlighting the value of indigenous knowledge in mathematics education, this study advocates for a more inclusive and contextually relevant approach to teaching that respects and celebrates the cultural identities of all students. Ultimately, this article seeks to demonstrate that empowering students through the integration of indigenous knowledge in mathematics education can lead to more meaningful and effective learning experiences, thereby promoting educational equity and excellence in Southern Province, Zambia.

Problem Statement

In Southern Province, Zambia, the teaching of mathematics often relies heavily on Western pedagogical approaches, which are not always congruent with the cultural contexts and indigenous knowledge systems of the students. This misalignment can lead to disengagement, poor comprehension, and low academic performance among students, particularly those from rural and indigenous backgrounds. Traditional mathematics education fails to leverage the rich mathematical concepts inherent in local practices, languages, and traditions, thereby missing an opportunity to make learning more relevant and accessible.

Studies have shown that culturally responsive teaching methods can significantly enhance student engagement and academic achievement. For instance, research by Ladson-Billings (1995) and Gay (2010) has demonstrated that integrating students' cultural backgrounds into the curriculum can lead to better educational outcomes. In the African context, scholars like Aikenhead and Jegede (1999) and Semali and Kincheloe (1999) have highlighted the benefits of incorporating indigenous knowledge into science and mathematics education. Despite these findings, there is a notable lack of research specifically focusing on the indigenization of mathematics education in Zambia, leaving a gap in both academic literature and practical application.

The magnitude of the problem is evident in the persistent low performance of Zambian students in mathematics, as reported by national assessments and international evaluations like the Southern and Eastern Africa Consortium for Monitoring Educational Quality (SACMEQ). Without addressing the cultural disconnect in mathematics education, students will continue to struggle, potentially leading to higher dropout rates, diminished interest in STEM fields, and a broader educational inequity. The failure to resolve this problem could have long-term detrimental effects on both individual students and the broader community. Students who do not develop strong mathematical skills are less likely to pursue careers in science, technology, engineering, and mathematics (STEM), which are critical for the socio-economic development of Zambia. Furthermore, the lack of cultural relevance in education can contribute to a sense of alienation and disengagement from the educational system as a whole.

Therefore, there is an urgent need for this study to explore the potential benefits of indigenizing mathematics education in Southern Province, Zambia. By investigating how the integration of indigenous knowledge can enhance student engagement and academic performance, this research aims to provide evidence-based recommendations for educators and policymakers. This study will contribute to the academic discourse on culturally responsive teaching and offer practical solutions for making mathematics education more inclusive and effective. This research addresses a critical gap in the existing literature and educational practice. By empowering students through the incorporation of their cultural heritage into mathematics education, we can foster a more engaging, relevant, and effective learning environment that not only improves academic outcomes but also promotes educational equity and cultural pride.

Objective

1. To Evaluate the Benefits of Indigenizing Mathematics Education on Empowering Students in Southern Province, Zambia

Research Question

2. What are the benefits of indigenizing mathematics education on empowering students in Southern Province?

Hypothesis

(H0): Indigenizing mathematics education does not significantly impact student empowerment, engagement, or academic performance in Southern Province, Zambia.

(H1): Indigenizing mathematics education significantly enhances student empowerment, engagement, and academic performance in Southern Province, Zambia.

SIGNIFICANCE OF THE STUDY

This study on the benefits of indigenizing mathematics education in Southern Province, Zambia, holds considerable significance for several reasons. By integrating indigenous knowledge into the mathematics curriculum, this study aims to make learning more relevant and engaging for students. This can lead to improved academic performance and a deeper understanding of mathematical concepts, addressing current challenges in mathematics education. The study emphasizes the importance of cultural context in education. By incorporating local traditions, practices, and knowledge, it highlights the value of students' cultural heritage, fostering a sense of pride and identity among learners. The findings of this study will provide valuable insights for educators, curriculum developers, and policymakers. The evidence-based recommendations will support the creation of more inclusive and effective educational strategies that consider the cultural backgrounds of students. This research will add to the body of literature on culturally responsive teaching and the indigenization of education. It will offer new perspectives and data on the impact of integrating indigenous knowledge into the curriculum, particularly in the context of mathematics education in Zambia.

By addressing the educational needs of students from diverse cultural backgrounds, the study aims to promote equity in education. It seeks to ensure that all students, regardless of their cultural background, have access to a meaningful and effective education that respects and incorporates their cultural identities. While the study focuses on Southern Province, Zambia, its findings may have broader implications for other regions and countries with similar cultural and educational contexts. The principles and strategies identified could be adapted and applied in various settings to improve mathematics education globally. By recognizing and valuing indigenous knowledge, the study empowers local communities, affirming the significance of

their cultural contributions to education. This can enhance community involvement and support for educational initiatives, leading to a more collaborative and holistic approach to education. This study aims to demonstrate that indigenizing mathematics education can lead to a more engaging, relevant, and effective learning experience, ultimately empowering students and promoting educational equity in Southern Province, Zambia. The insights gained will inform future educational practices and policies, benefiting students, educators, and communities.

THEORETICAL FRAMEWORKS ON INDIGENIZING EDUCATION:

The indigenization of education involves integrating indigenous knowledge, practices, and perspectives into educational frameworks to enhance cultural relevance and empowerment for students. Key theoretical frameworks supporting this approach include culturally responsive pedagogy and the concept of funds of knowledge. Culturally responsive pedagogy emphasizes acknowledging and valuing students' cultural backgrounds in the learning process (Aguirre et al., 2012). Funds of knowledge refer to the wealth of knowledge, skills, and experiences individuals acquire from their homes and communities, which can be utilized to improve educational outcomes (Cannella, 2007).

Pioneering scholars in this field, such as Aguirre, have emphasized the importance of incorporating students' cultural funds of knowledge into mathematics education to enhance learning (Aguirre et al., 2012). Additionally, researchers like Cannella have theorized about practices in households, communities, and classrooms, highlighting the value of understanding and utilizing funds of knowledge in educational settings (Cannella, 2007).

By integrating indigenous knowledge alongside traditional educational content, educators can promote cultural equity, enhance student motivation, and foster community ownership of the educational process (Riggs, 2005). When educators adopt a funds of knowledge pedagogical approach, they strive to connect students' home knowledge and practices with the curriculum to optimize learning outcomes (Álvarez, 2017). This approach not only acknowledges the rich cultural heritage of students but also leverages their existing knowledge base to create more meaningful and effective educational experiences.

Moreover, the indigenization of education aligns with the principles of social justice, aiming to rectify historical marginalization of indigenous cultures within educational systems. It challenges the dominance of Western-centric curricula and promotes a more inclusive and equitable educational landscape. This shift not only benefits indigenous students but also enriches the learning experiences of all students by exposing them to diverse worldviews and knowledge systems.

The application of culturally responsive pedagogy and funds of knowledge in education involves several practical strategies. Teachers can incorporate culturally relevant examples and contexts in their lessons, engage with community members to understand local knowledge and practices, and create learning environments that reflect and respect students' cultural identities. Professional development for educators is also crucial, equipping them with the skills and understanding needed to effectively implement these approaches.

Historical Context of Mathematics Education in Zambia

The historical development of mathematics education in Zambia has been significantly influenced by colonial education systems and post-independence educational reforms. During the colonial era, education in Zambia was primarily designed to serve the interests of the colonial powers, with limited access to formal education for the majority of the population. Private correspondence colleges linked to Britain, the colonial masters, provided education to a select few who could afford it (Makoe, 2018).

Since gaining independence, Zambia has undergone several educational policy reforms aimed at improving access to quality education for all. The Curriculum Development Centre (CDC) has played a central role in developing the school curriculum during both the colonial and post-colonial eras (Munyeme & Kalebwe, 2001). However, challenges persist in aligning mathematics education with local contexts and needs. The growth of education in Zambia since independence has been a gradual process, marked by various educational policy documents such as the Educational Reforms in 1977, Focus on Learning in 1992, and Educating our Future in 1996 (Banja & Mulenga, 2019). Efforts to enhance mathematics education in Zambia have also involved exploring innovative methodologies and integrating local culture into learning materials. For instance, there have been calls to develop learning materials based on Realistic Mathematics Education with a local cultural context to improve students' mathematical communication ability and self-efficacy (Lestari et al., 2018). Realistic Mathematics Education (RME) focuses on the application of mathematics in real-life contexts, making learning more relevant and meaningful for students. By incorporating local cultural contexts into RME, educators can create more engaging and relatable learning experiences that resonate with students' everyday lives.

Additionally, the use of ethno-modelling has been suggested as a way to document the historical forms of mathematical ideas, procedures, and practices developed in diverse cultural contexts (Rosa & Orey, 2022). Ethnomodelling involves the study and application of mathematical concepts that arise from the cultural practices and traditions of different communities. By integrating ethnomodelling into the curriculum, educators can highlight the mathematical contributions of various cultures, fostering a deeper appreciation for the diversity of mathematical thought and its relevance to students' cultural backgrounds.

The integration of local culture into mathematics education not only enhances the learning experience but also promotes cultural pride and identity among students. By recognizing and valuing indigenous knowledge and practices, educators can create a more inclusive and equitable educational environment. This approach aligns with the broader goals of educational equity and social justice, aiming to provide all students with access to quality education that respects and incorporates their cultural identities.

Indigenous Knowledge Systems and Their Role in Education:

Indigenous knowledge systems encompass the traditional knowledge, practices, and beliefs of various communities. In Zambia, these systems have played a significant role in the cultural heritage of the nation. The integration of indigenous knowledge into formal education has been a gradual process in the country. The evolution of mathematics teacher education curricula in Zambia has aimed to incorporate a deeper understanding of soft skills, which are integral components of indigenous knowledge systems (Changwe, 2022; Busaka et al., 2022). By enhancing teachers' conceptual understanding of soft skills, educators can better grasp the holistic nature of indigenous knowledge and its importance in education.

Furthermore, mathematics teacher education plays a crucial role in addressing narrow neocolonial views of mathematics. Sensitizing teachers to the impact of neocolonial approaches and promoting culturally relevant mathematics education can facilitate the integration of indigenous knowledge (Owens, 2023). Understanding the values and preferences of diverse student populations, such as Pāsifika students in New Zealand, emphasizes the significance of aligning pedagogical approaches with students' cultural backgrounds and indigenous perspectives (Hill et al., 2019). This approach ensures that education is not only inclusive but also respectful of the diverse cultural heritage that students bring into the classroom.

The COVID-19 pandemic has accelerated the adoption of remote learning, which has significant implications for mathematics education in Zambia. The shift to online platforms has underscored the need for infrastructure supporting blended and online learning models. This transition highlights the importance of adapting educational practices to meet students' evolving needs while considering indigenous knowledge

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS |Volume VIII Issue VIII August 2024

systems (Mukuka et al., 2021). Integrating indigenous knowledge into digital learning environments is essential to maintain cultural relevance and inclusivity in education. As educators adapt to new teaching modalities, ensuring that indigenous knowledge systems are represented and respected in these formats is crucial.

Moreover, incorporating indigenous knowledge into mathematics education can enrich the curriculum by providing students with a broader context for understanding mathematical concepts. For example, traditional methods of counting, measuring, and problem-solving can offer alternative perspectives and enhance students' comprehension of mathematical principles. By drawing on the rich cultural heritage and practical knowledge embedded in indigenous systems, educators can create a more engaging and meaningful learning experience for students. The integration of indigenous knowledge into education also supports the development of critical thinking and problem-solving skills. Indigenous knowledge systems often emphasize practical, hands-on learning and holistic approaches to understanding the world. These methods can complement and enhance traditional educational practices, providing students with a well-rounded and robust educational experience.

Benefits of Culturally Relevant Pedagogy

Culturally relevant pedagogy has demonstrated various benefits in educational settings. Research has shown that integrating indigenous knowledge into the curriculum can lead to improvements in student engagement, academic performance, and cultural identity (Aguirre et al., 2012; Alameddine, 2021). Alameddine highlighted that culturally relevant pedagogy supports culturally and linguistically diverse students in achieving high academic success while maintaining their cultural identities. Morales-Doyle (2017) emphasized that justice-centered science pedagogy, rooted in culturally relevant principles, can act as a catalyst for academic achievement and social transformation (Cannella, 2007).

Moreover, Nxumalo & Mncube (2018) discussed the use of indigenous games and knowledge to decolonize the school curriculum, promoting Ubuntu perspectives and enhancing cultural relevance in education (Riggs, 2005). This approach not only enriches the curriculum but also fosters a sense of community and shared cultural values among students. Howlett et al. (2008) explored strategies to retain Indigenous students in tertiary education, emphasizing the importance of culturally relevant approaches in supporting student success (Álvarez, 2017). Their findings suggest that when educational content reflects students' cultural backgrounds, it can lead to higher retention rates and better academic outcomes.

Additionally, Mashoko (2022) highlighted the significance of incorporating indigenous artifacts and cultural perspectives into the physics curriculum to teach science as a cultural way of knowing (Makoe, 2018). This integration helps students see the relevance of scientific concepts in their own cultural contexts, making learning more meaningful and relatable. Furthermore, Stagg-Peterson et al. (2022) discussed the awakening of Indigenous knowledge among Early Childhood Education Diploma students through community-generated curricula that embody local Indigenous cultural knowledge, values, and practices, leading to a deeper connection with their cultural heritage (Munyeme & Kalebwe, 2001).

These studies collectively underscore the positive impact of culturally relevant pedagogy and the integration of indigenous knowledge in enhancing student learning outcomes, fostering cultural pride, and promoting academic success across diverse educational settings. The implementation of culturally relevant pedagogy involves recognizing and valuing students' cultural backgrounds, integrating local knowledge and practices into the curriculum, and creating an inclusive educational environment that respects and celebrates diversity.

By incorporating indigenous knowledge and culturally relevant pedagogical approaches, educators can create a more engaging and effective learning experience for all students. This approach not only improves

academic performance but also helps students develop a strong sense of cultural identity and pride. Moreover, it promotes social justice by addressing historical inequities in education and providing all students with equal opportunities to succeed.

Challenges and Barriers to Indigenizing Mathematics Education

Implementing indigenized mathematics education faces several challenges that can hinder its successful integration into educational systems. Resistance from educators, lack of resources, and potential tensions between traditional and modern educational practices are key obstacles to overcome.

Resistance from educators poses a significant challenge to the implementation of indigenized mathematics education. Educators may be hesitant to adopt new pedagogical approaches that incorporate indigenous knowledge due to unfamiliarity, lack of training, or personal biases (Barton, 2023). Overcoming this resistance requires professional development opportunities, cultural competency training, and ongoing support to help educators understand the value of integrating indigenous perspectives into the curriculum. Professional development programs should focus on equipping teachers with the knowledge and skills necessary to incorporate indigenous content effectively, while cultural competency training can help educators appreciate the importance of culturally relevant pedagogy.

A lack of resources, both material and human, can also impede the indigenization of mathematics education. Insufficient funding for curriculum development, limited access to culturally relevant teaching materials, and a shortage of educators with expertise in indigenous knowledge systems can hinder progress in this area (Stavrou, 2021). Addressing resource gaps requires investment in curriculum development, teacher training programs, and partnerships with indigenous communities to co-create educational materials. Financial support from government bodies, NGOs, and private sectors can facilitate the production and dissemination of culturally appropriate resources. Additionally, recruiting and training educators from indigenous backgrounds can ensure that the curriculum is delivered effectively and respectfully.

Moreover, tensions between traditional and modern educational practices may arise when attempting to integrate indigenous knowledge into mathematics education. Balancing the preservation of cultural traditions with the demands of a modern educational system can create challenges in curriculum design, assessment methods, and pedagogical approaches (Melville, 2017). Finding a harmonious integration that respects both indigenous ways of knowing and academic standards is essential for the success of indigenized mathematics education. This requires a collaborative approach involving educators, curriculum developers, and community leaders to create a curriculum that honors indigenous knowledge while meeting educational standards.

In addressing challenges such as educator resistance, resource limitations, and tensions between traditional and modern practices is crucial for the effective implementation of indigenized mathematics education. By promoting cultural awareness, investing in resources, and fostering collaboration between stakeholders, educational systems can overcome these barriers and create inclusive learning environments that honor indigenous knowledge and enhance student engagement and academic performance. Through concerted efforts, it is possible to develop a mathematics curriculum that not only respects and preserves indigenous heritage but also equips students with the skills they need to succeed in a globalized world.

Impact on Student Empowerment

To explore the concept of student empowerment in education and its correlation with the integration of indigenous knowledge, it is crucial to examine studies that have assessed the impact of culturally relevant education on students' sense of empowerment, self-efficacy, and academic identity. Research by Suarta et al. (2022) underscores that teachers' incorporation of indigenous knowledge has a positive influence on students

and their parents, suggesting that culturally relevant education can boost student engagement and learning outcomes. This study indicates that when students see their cultural heritage reflected in their education, they are more likely to feel valued and motivated, leading to improved academic performance and a stronger sense of self-efficacy.

Similarly, Sianturi et al. (2018) discovered that a place-based education curriculum positively affected indigenous teacher empowerment and enhanced indigenous students' learning achievements, illustrating the potential of culturally relevant approaches to empower both educators and students. Place-based education, which connects learning to the local community and environment, helps students understand the relevance of their education to their lives and surroundings, thereby fostering a deeper connection to their academic work and their cultural identity. Moreover, studies such as Rigby et al. (2011) emphasize the significance of establishing culturally safe learning environments to empower students and equip them for academic success. Culturally safe learning environments respect and affirm students' cultural identities, making them feel secure and supported. This sense of safety and acceptance is crucial for fostering student empowerment, as it allows students to express themselves freely and take ownership of their learning.

The Australian Indigenous Mentoring Experience (AIME) program, as discussed by Harwood et al. (2015), notably inspires Indigenous high school students to aspire to further study, training, or employment, demonstrating the positive impact of culturally relevant mentoring initiatives on student aspirations and empowerment. The AIME program shows that mentorship and support from culturally knowledgeable mentors can significantly boost students' confidence and aspirations, encouraging them to pursue higher education and career opportunities. Additionally, Efimoff (2023) found that engagement with Indigenization resulted in both positive and negative impacts on students, highlighting the complexities of empowerment through cultural initiatives. While many students benefit from seeing their culture integrated into their education, some may struggle with the added pressure to represent their culture or reconcile traditional knowledge with mainstream educational expectations. This finding underscores the importance of carefully and thoughtfully implementing indigenization initiatives to maximize positive outcomes and address potential challenges.

Furthermore, Deer & Heringer (2023) discuss the challenge of integrating Indigenous Knowledge into educational practices and stress the importance of community empowerment in promoting student achievement at the cultural interface. They argue that successful integration of indigenous knowledge requires the involvement and support of the entire community, including elders, parents, and local leaders. Community empowerment ensures that educational practices are culturally relevant and sustainable, and that students receive consistent messages about the value of their cultural heritage both at school and at home.

Methodological Approaches in Indigenizing Education Research

Research on the indigenization of education employs various methodological approaches to study the integration of indigenous knowledge into educational practices. Qualitative, quantitative, and mixed-methods research designs are commonly utilized to explore the impact of culturally relevant education on students' empowerment, self-efficacy, and academic identity. Additionally, participatory and community-based research methods play a crucial role in this context by ensuring the active involvement of Indigenous communities in the research process.

Studies such as Wilkinson et al. (2016) and Davíd-Chavez et al. (2020) highlight the use of Participatory Action Research (PAR) and Indigenous research methodologies to engage communities in the research process, fostering collaboration and empowering both educators and students. PAR, in particular, emphasizes a cyclical process of planning, acting, observing, and reflecting, which aligns well with Indigenous ways of knowing and allows for the co-creation of knowledge that is both relevant and beneficial

to the community. This approach helps bridge the gap between researchers and participants, ensuring that the research process respects and incorporates Indigenous perspectives and knowledge. Nadeau et al. (2022) emphasize the challenges of decolonizing participatory research in Indigenous contexts, underscoring the importance of adopting a decolonization framework in research practices. Decolonizing research involves critically examining and challenging the power dynamics and colonial legacies embedded in traditional research methodologies. It requires a commitment to valuing Indigenous epistemologies and methodologies, and to fostering genuine partnerships that prioritize the needs and voices of Indigenous communities.

Community-based research approaches, as discussed by Tsai et al. (2022) and Rodgers et al. (2020), enable genuine participation of local populations and tap into their indigenous knowledge, promoting community empowerment and knowledge exchange. Community-based participatory research (CBPR) focuses on collaborative partnerships between researchers and community members throughout the research process, from the initial design to the dissemination of findings. This approach ensures that the research is grounded in the local context and addresses the specific needs and concerns of the community. Furthermore, studies like Moore & Eapen (2019) and File & Derbile (2020) demonstrate the benefits of participatory research with Indigenous peoples, emphasizing the importance of collaborative partnerships and the co-creation of knowledge. These studies show that when Indigenous communities are actively involved in the research process, the resulting knowledge is more likely to be relevant, actionable, and empowering. Co-creating knowledge with Indigenous communities helps to ensure that research findings are culturally appropriate and practically useful for improving educational practices and outcomes.

Gaps in the Existing Literature on Indigenizing Mathematics Education

Indigenizing mathematics education is a multifaceted field that necessitates further research to address existing gaps, particularly within the Zambian context. While literature recognizes the significance of integrating Indigenous knowledge and culture into mathematics education (Naidoo, 2021; Stavrou, 2021), more studies are needed to focus on the challenges and opportunities specific to the Zambian educational system.

One crucial area requiring attention is the development of culturally relevant pedagogical approaches that resonate with Indigenous students in Zambia. Research indicates that culturally based activities can improve the comprehension of mathematical concepts and enhance the meaningfulness of learning for Indigenous students (Naidoo, 2021). Therefore, additional exploration into integrating Indigenous knowledge and culturally based activities into the Zambian mathematics curriculum is warranted. For instance, incorporating traditional counting systems, local measurement units, and culturally relevant problem-solving scenarios could make mathematics more relatable and engaging for students.

Furthermore, it is essential to investigate the impact of language on Indigenous students' engagement and achievement in mathematics. Language plays a pivotal role in mathematical learning, with studies demonstrating that instructional language can influence students' grasp of mathematical concepts (Warren & Miller, 2013). In Zambia, characterized by linguistic diversity, exploring how language practices can support Indigenous students in effectively learning mathematics is crucial. Research could focus on the benefits of bilingual education or the use of local languages in teaching mathematical concepts, as well as the development of language-sensitive teaching materials.

Additionally, addressing the achievement gap between Indigenous and non-Indigenous students in mathematics education is a critical area necessitating further investigation. Studies have highlighted disparities in educational outcomes between these student groups (Song et al., 2014), underscoring the need for targeted interventions to promote equity in mathematics education. Understanding the factors contributing to this achievement gap in the Zambian context and devising strategies to mitigate it are

essential for advancing the field of Indigenizing mathematics education. This might include examining socio-economic factors, teacher attitudes, and resource availability, as well as implementing and evaluating programs designed to support Indigenous students.

METHODOLOGY

The methodology section of this study outlines the systematic approach taken to investigate the benefits of indigenizing mathematics education in Southern Province, Zambia. A sequential exploratory mixed-methods design was employed, starting with quantitative data collection followed by qualitative data gathering. This approach was selected to provide a comprehensive understanding of the research problem by integrating numerical data with detailed personal insights.

Research Design

This research adopted a sequential exploratory mixed-methods design, beginning with quantitative data collection followed by qualitative data gathering. This method was chosen to provide a holistic understanding of the benefits associated with indigenized mathematics education in Southern Province, Zambia. The approach allows for the initial quantitative data to inform the subsequent qualitative phase, ensuring a comprehensive exploration of the research problem. In the quantitative phase, a structured questionnaire was administered to gather measurable data on teachers' perceptions and professional development needs. This phase aimed to capture a broad perspective from a large sample of mathematics teachers, providing a foundation for identifying key trends and patterns.

Following the quantitative phase, the qualitative phase involved in-depth interviews and focus group discussions with selected teachers. This phase aimed to delve deeper into the insights and experiences of the participants, enriching the quantitative findings with detailed, context-specific information. By integrating both quantitative and qualitative data, the study sought to achieve a nuanced and robust understanding of the benefits of indigenizing mathematics pedagogies and practices in the region.

Target Population

Creswell (2014) emphasizes that the target population in a study refers to the specific group of individuals or entities from which the researcher intends to draw conclusions. Dillman et al. (2014) suggest that understanding the target population is crucial for ensuring that the research findings are relevant and applicable to the intended audience.

For this study, the target population comprises mathematics teachers in Southern Province, Zambia. Focusing on teachers is essential as they are the primary agents in implementing curriculum changes and incorporating indigenous knowledge into mathematics education. By examining the perspectives of mathematics teachers, the study aims to uncover valuable insights into the opportunities they perceive in integrating indigenized pedagogies and practices.

Study Sample Size

Cohen et al. (2006) define a research sample as a subset of the population selected for a study. The size of the sample is a critical factor in research as it influences the reliability and generalizability of the findings. Trochim and Donnelly (2008) note that larger sample sizes reduce sampling error and provide more accurate representations of the population. For this study, the sample size was meticulously determined to balance practical considerations and statistical reliability. The quantitative sample size was calculated using an online calculator with parameters set at a 95% confidence level, a 5% margin of error, and a population proportion of 50% mathematics teachers in Southern Province, Zambia. These parameters ensured the

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS |Volume VIII Issue VIII August 2024

sample size would yield reliable and accurate results.

The sample size for the study was meticulously determined to ensure a comprehensive and representative understanding of the research problem. The total number of respondents who participated in this study was 343. The sample consisted of both quantitative and qualitative components as detailed below:

The quantitative sample size for the study consisted of 326 participants, broken down as follows: 55 mathematics teachers selected through stratified random sampling to ensure diversity in teaching experience and qualifications, and 271 students selected through random sampling within each participating teacher's classes, focusing on students doing mathematics at Grade 12 level.

The qualitative sample size for the study consisted of 17 participants, broken down as follows: 10 parents selected through purposive sampling to provide insights into the cultural relevance and community acceptance of indigenized education, 1 member from the District Education Board Secretary's office selected through purposive sampling to provide policy-level insights and perspectives on indigenized mathematics education, and 6 school administrators selected through purposive sampling to include those with experience in both traditional and indigenized education systems.

The total number of respondents who participated in this study was 343, combining both the quantitative and qualitative samples to provide a robust foundation for analysis and discussion. The rationale for sample selection was to ensure comprehensive representation, balanced insights, and focused relevance. The inclusion of teachers, students, parents, and educational administrators ensures that the study captures a wide range of perspectives and experiences, making the findings more comprehensive and applicable to different stakeholders. The combination of quantitative and qualitative data allows for a detailed exploration of the research questions, with quantitative data providing broad trends and qualitative data offering deep, contextual insights. By focusing on Grade 12 students, the study addresses a critical educational stage where the impact of indigenized mathematics education can be most effectively evaluated. This carefully structured sample size and composition ensure that the study's findings are both reliable and insightful, contributing valuable knowledge to the field of indigenized mathematics education in Southern Province, Zambia.

Sampling Techniques

This study employed a combination of stratified random sampling and purposive sampling techniques to select participants for both the quantitative and qualitative data collection phases.

For the quantitative phase, stratified random sampling was used. This technique involves dividing the population into distinct subgroups or strata based on specific criteria such as teaching experience and methods used in mathematics education (Cohen et al., 2006). The mathematics teachers in Southern Province were categorized into three groups: novice teachers with less than 5 years of experience, mid-career teachers with 5 to 15 years of experience, and experienced teachers with more than 15 years of experience. Random samples were then selected from each stratum to ensure a diverse and representative sample (Trochim & Donnelly, 2008).

For the qualitative phase, purposive sampling was employed. This technique involves deliberately selecting participants based on specific criteria relevant to the research questions. In this study, 15 mathematics teachers with extensive experience in indigenized education practices were chosen for in-depth interviews. These participants were selected for their ability to provide rich, detailed data pertinent to the study's objectives (Trochim & Donnelly, 2008).

The use of stratified random sampling for the quantitative phase and purposive sampling for the qualitative phase ensured a comprehensive understanding of teachers' perspectives on indigenized mathematics

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS |Volume VIII Issue VIII August 2024

education in Southern Province, Zambia. Stratified random sampling provided a broad, representative sample for quantitative analysis, while purposive sampling facilitated in-depth qualitative insights.

Data Collection Instruments

A range of data collection instruments was used to gather comprehensive data from participants. These instruments included questionnaire surveys and interview guides. Dillman (2011) describes questionnaire surveys as a method of collecting quantitative data by posing a set of questions to participants. Fowler (2013) notes that surveys are effective for gathering data from large groups. In this study, questionnaires were designed to collect data from 55 mathematics teachers regarding their current teaching practices, pedagogical approaches, and perceptions of indigenized education.

Kvale (2014) defines semi-structured interviews as a qualitative research method used to collect detailed information from participants. These interviews follow a flexible guide with open-ended questions, allowing participants to express their thoughts freely. In this study, 15 mathematics teachers were selected for semi-structured interviews to explore their experiences and insights into indigenized mathematics education.

Data Collection Procedures

The data collection procedures were carefully designed to ensure accuracy and comprehensiveness. A questionnaire was developed to collect quantitative data on teachers' current practices, pedagogical methods, and attitudes towards indigenized education. The questionnaire was pilot tested with a small group of 10 teachers to identify any issues and ensure clarity. Feedback from the pilot test was used to refine the questionnaire.

The finalized questionnaire was distributed to 55 mathematics teachers in Southern Province through online platforms and printed copies, depending on accessibility. Teachers were given two weeks to complete the survey, with reminders sent to ensure a high response rate. Completed questionnaires were compiled into a database for analysis, with online responses recorded automatically and printed responses entered manually. Data integrity checks were performed to ensure accuracy.

An interview guide was developed for semi-structured interviews, focusing on open-ended questions about teachers' experiences and perspectives on indigenized mathematics education. Fifteen teachers were purposively selected for interviews based on their extensive experience. Participants were contacted, informed about the study, and consent was obtained. Interviews were conducted face-to-face or via telephone/online platforms, lasting 45 to 60 minutes. Interviews were audio-recorded with consent and detailed notes were taken. Audio recordings were transcribed verbatim for detailed analysis. Transcriptions were reviewed for accuracy and organized for coding and thematic analysis.

Data Processing and Analysis

The data processing and analysis procedures were meticulously designed to ensure accurate and insightful interpretations. Quantitative data from the questionnaires were compiled into a database and analyzed using statistical analysis software, SPSS. Descriptive statistics (frequencies, percentages, means, and standard deviations) summarized the teachers' demographic information and attitudes towards indigenized education. Inferential statistics (t-tests) examined differences and relationships between variables.

Quantitative data analysis began with descriptive statistics to provide an overview of teachers' perceptions regarding the current state of mathematics education and the potential benefits of indigenizing the curriculum. Mean scores and standard deviations were calculated for each variable to summarize central tendencies and variability. For example, the mean score of 4.20 for the belief in the potential benefits of

indigenizing mathematics education indicates strong agreement among teachers, with a standard deviation of 0.75 suggesting moderate variability in this perception. Similarly, variables such as the relevance of the current curriculum (mean = 3.10) and perceived community support (mean = 4.05) provided insights into the current educational context and readiness for change.

Correlation analysis was then performed to determine the strength and direction of relationships between key variables. For instance, a correlation coefficient of 0.68 between the perception of indigenization benefits and student engagement indicates a strong positive relationship, suggesting that teachers who perceive higher benefits of indigenizing mathematics education also report higher student engagement. These correlations provide evidence of how perceptions of indigenization might impact practical educational outcomes.

Comparative analysis of perceptions among different groups was conducted by comparing mean scores and standard deviations across teachers, students, parents, school administrators, and the District Education Board. This analysis helped identify any significant differences or similarities in perceptions among these groups. For example, parents (mean = 4.30) and school administrators (mean = 4.25) showed slightly higher agreement with the benefits of indigenizing mathematics education compared to teachers (mean = 4.20) and students (mean = 4.15). Understanding these differences is crucial for tailoring implementation strategies to address the concerns and expectations of various stakeholders.

The frequency distribution of teachers' responses was analyzed to determine the levels of agreement or disagreement with key questions about indigenizing mathematics education. For instance, a majority of teachers (45 out of 55) agreed or strongly agreed that indigenizing mathematics can enhance students' understanding by relating concepts to their cultural context. Such distributions provide a detailed view of teachers' sentiments and highlight areas of consensus and contention.

Hypothesis testing was conducted to evaluate the study's hypothesis. The null hypothesis (H0) posited that indigenizing mathematics education does not significantly impact student empowerment, engagement, or academic performance in Southern Province, Zambia. The alternative hypothesis (H1) proposed that indigenizing mathematics education significantly enhances these aspects. The descriptive statistics and correlation analysis provided strong evidence supporting the alternative hypothesis. The high mean scores and strong positive correlations between the perception of indigenization benefits and student engagement/performance indicated significant potential impacts. Based on these findings, the null hypothesis was rejected, and the alternative hypothesis was accepted, concluding that indigenizing mathematics education significantly enhances student empowerment, engagement, and academic performance.

Qualitative data analysis involved transcription and coding of interview data. Qualitative data from the interviews were transcribed verbatim and organized for coding. Thematic analysis was employed to identify patterns and themes within the data, involving reading and re-reading transcripts, generating initial codes, searching for themes, reviewing themes, defining and naming themes, and producing the final report. To ensure reliability and validity, member checking was conducted to verify the accuracy of transcriptions and interpretations with participants. Peer debriefing involved discussing findings with colleagues to ensure credible interpretations, and triangulation compared findings from questionnaires, interviews, and focus groups for a comprehensive understanding.

By integrating quantitative and qualitative data, the study provided a robust and nuanced understanding of the potential benefits of indigenizing mathematics education. This comprehensive approach ensured that the findings were both reliable and insightful, contributing valuable knowledge to the field of indigenized mathematics education in Southern Province, Zambia.

Reliability and Validity of the Study

Ensuring the reliability and validity of the study was crucial for producing credible findings. The internal consistency of the questionnaire was assessed using Cronbach's alpha, and pilot testing was conducted to refine the survey instrument. To ensure test-retest reliability, a subset of participants completed the questionnaire twice, with a two-week interval between administrations, and their responses were analyzed for consistency. For inter-rater reliability, multiple researchers independently coded a subset of the interview transcripts, and discrepancies were discussed and resolved to ensure consistent coding.

Content validity was established by having a panel of experts review the questionnaire and interview guide, ensuring they covered all relevant aspects of the research topic. Construct validity was supported by conducting exploratory factor analysis (EFA), which confirmed that the questionnaire items accurately measured the underlying constructs. Criterion validity was demonstrated through consistent findings across different methods, indicating strong criterion validity. Predictive validity was examined by exploring the relationship between teachers' attitudes towards indigenous pedagogies and their reported teaching practices.

Triangulation was achieved by using multiple data collection methods, including questionnaire surveys, semi-structured interviews, and focus groups, and involving various participants to ensure a comprehensive understanding of the topic. This combination of strategies ensured the reliability and validity of the study, providing robust and trustworthy findings.

Ethical Considerations

Ethical considerations were carefully addressed to ensure the protection and rights of participants. Participants were informed about the study's purpose, procedures, potential risks, and benefits, and written informed consent was obtained from all participants. Data were kept confidential and securely stored, with personal identifiers removed to ensure anonymity. The study protocol was reviewed and approved by the relevant institutional ethics committee, ensuring adherence to ethical standards.

Potential risks to participants were assessed and minimized, and participants were provided with contact information for the research team in case they had any concerns or experienced distress. The research team-maintained transparency about the study's aims and procedures and conducted the study with respect for all participants. Participants were given the option to receive a summary of the study's findings, ensuring they were informed of the outcomes and the impact of their participation. By adhering to these ethical considerations, the study aimed to uphold the highest standards of ethical conduct, ensuring the protection, respect, and well-being of all participants involved in the research on the benefits of indigenized mathematics education in Southern Province, Zambia.

PRESENTATION OF RESULTS, FINDINGS, AND DISCUSSION

This section presents the results, findings, and discussion of the study, which aimed to evaluate the benefits of indigenizing mathematics education on empowering students in Southern Province, Zambia. The primary objective was to assess how the integration of indigenous knowledge into the mathematics curriculum impacts student empowerment, engagement, and academic performance.

The research was guided by the following hypothesis:

- **Null Hypothesis (H0):** Indigenizing mathematics education does not significantly impact student empowerment, engagement, or academic performance in Southern Province, Zambia.
- **Alternative Hypothesis (H1):** Indigenizing mathematics education significantly enhances student empowerment, engagement, and academic performance in Southern Province, Zambia.

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS |Volume VIII Issue VIII August 2024

To achieve a comprehensive understanding, the study employed a sequential exploratory mixed-methods design, combining quantitative and qualitative data. The quantitative phase involved administering structured questionnaires to gather measurable data on teachers' perceptions and professional development needs. The qualitative phase included in-depth interviews and focus group discussions with selected teachers to delve deeper into their experiences and insights.

The presentation of results will begin with the quantitative data, providing an overview of the broad trends and patterns identified. This will be followed by the qualitative findings, which will offer detailed, context-specific information that enriches and contextualizes the quantitative data. The discussion will integrate these findings, addressing the research hypotheses and evaluating the extent to which indigenizing mathematics education empowers students. This comprehensive analysis aims to offer valuable insights into the potential benefits and practical implications of integrating indigenous knowledge into the mathematics curriculum in Southern Province, Zambia.

Table 1: Table with variables showing the response of students on the benefits of indigenizing mathematics education in Southern Province, Zambia:

SN	Description	N	Mean	Standard Deviation
1	Relating mathematical concepts to cultural context enhances understanding	271	4.25	0.7
2	Indigenous knowledge in mathematics improves student engagement and interest	271	4.15	0.75
3	Indigenized mathematics education fosters student pride and identity	271	4.1	0.72
4	Bridging the gap between traditional knowledge and formal education through indigenized methods	271	4.05	0.68
5	Strengthening school-community relationships through community involvement in indigenized mathematics	271	4.2	0.74
6	Developing new and locally relevant teaching resources through indigenizing the curriculum	271	4.18	0.69
7	Enhancing teachers' instructional practices through professional development in indigenous pedagogies	271	4.22	0.71
8	Contributing to the preservation of indigenous knowledge and cultural heritage through indigenized education	271	4.3	0.65
9	Promoting holistic and well-rounded student development through integrating indigenous practices in mathematics	271	4.12	0.73
10	Innovating teaching methods through collaborative efforts between educators and indigenous communities	271	4.14	0.7
11	Addressing diverse learning needs through indigenized mathematics education	271	4.11	0.68
12	Improving standardized assessment performance by contextualizing problems through indigenized education	271	4.05	0.72
13	Encouraging critical thinking and problem-solving skills through culturally relevant mathematics	271	4.17	0.66
14	Increasing student motivation and participation in mathematics classes	271	4.13	0.74
15	Enhancing collaborative learning experiences among students through shared cultural knowledge	271	4.19	0.71
16	Reducing math anxiety by using familiar cultural contexts in teaching	271	4.08	0.75

17	Providing a more inclusive learning environment that respects and values cultural diversity	271	4.21	0.67
18	Encouraging parental involvement and support in students' education	271	4.16	0.7
19	Improving teacher-student relationships by acknowledging and integrating students' cultural backgrounds	271	4.23	0.68
20	Fostering a sense of community and belonging in the classroom	271	4.18	0.69

This table presents the mean scores and standard deviations for each item based on the responses from 271 students, focusing on promoting the benefits of indigenizing mathematics education in Southern Province, Zambia. The grand mean of 4.17 indicates a generally strong agreement among students on the positive impacts of indigenizing mathematics education.

Table 2: Descriptive Statistics of Teachers' Perceptions towards the benefits of Indigenized mathematics Education

This table provides an overview of teachers' perceptions regarding the current state of mathematics education and the potential benefits of indigenizing the curriculum.

SN	Variables	Correlation Coefficient (r)
1	Perception of indigenization benefits and student engagement	0.68
2	Perception of indigenization benefits and academic performance	0.72
3	Perception of indigenization benefits and community support	0.65
4	Readiness to incorporate indigenous knowledge and current teaching practices	0.58

Table 3: Correlation Analysis to show shows the relationship between teachers' perceptions of indigenization benefits and student engagement and academic performance.

This table shows the correlation coefficients between teachers' perceptions of the benefits of indigenizing mathematics education and various factors.

SN	Description	N	Mean	Standard Deviation
1		**55**	3.1	0.85
2		**55**	3.25	0.78
3		**55**	4.2	0.75
4		**55**	3.95	0.82
5		**55**	4.05	0.8

Table 4: Comparative Analysis of Perceptions Among Different Groups regarding the benefits of indigenizing mathematics education.

This table compares the perceptions of different groups regarding the benefits of indigenizing mathematics education.

SN	Group	N	Mean	Standard Deviation
1	Teachers	55	4.2	0.75
2	Students	271	4.15	0.77
3	Parents	10	4.3	0.68

4	School Administrators	6	4.25	0.7
5	District Education Board	1	4	

Table 5: Frequency Distribution of Teachers' Responses to key questions about indigenizing mathematics education.

This table presents the frequency distribution of teachers' responses to key questions about the potential benefits of indigenizing mathematics education.

SN	Question	SD	D	N	A	SA
1	Indigenizing mathematics can enhance students' understanding by relating concepts to their cultural context	2	3	5	30	15
2	Incorporating indigenous knowledge in mathematics education can improve student engagement and interest	1	4	7	28	15
3	Indigenized mathematics education can foster a sense of pride and identity among students	3	5	8	24	15
4	Teachers need professional development to implement indigenized methods	1	2	5	27	20

The qualitative component of this study aimed to provide deeper insights into the perceptions and experiences of stakeholders regarding the indigenization of mathematics education in Southern Province, Zambia. Thematic analysis was employed to analyse the qualitative data. Interviews were transcribed verbatim and coded to identify key themes. Through the thematic analysis of the qualitative data, five key themes emerged, providing a comprehensive understanding of the stakeholders' perspectives on the indigenization of mathematics education in Southern Province, Zambia.

Theme 1: Cultural Relevance in Education

Participants emphasized the importance of integrating indigenous knowledge into the mathematics curriculum to enhance cultural relevance and student engagement. Parents, in particular, highlighted how culturally relevant education makes learning more meaningful for their children.

One parent stated, "When my children see their culture reflected in their lessons, they are more interested and motivated to learn. It makes the education more meaningful to them."(P4)

Another parent echoed this sentiment, adding, "*It's important for our children to know their roots and see that our traditions have value, even in subjects like mathematics."(P7)*

Theme 2: Support and Challenges in Implementation

The theme of support and challenges in implementing indigenized education emerged as a significant concern among school administrators. While there was a strong belief in the benefits of indigenizing mathematics education, participants pointed out the need for adequate training and resources.

A school administrator remarked, *"We support the idea of indigenizing education, but we need proper training and resources to do it effectively. Without support, it will be difficult to make this transition."(H3)*

Another administrator added, "There is a lack of culturally relevant teaching materials. We need to develop

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS |Volume VIII Issue VIII August 2024

these resources to ensure that the curriculum is truly reflective of our indigenous knowledge."(H2)

Theme 3: Impact on Student Engagement and Performance

Participants discussed the positive impact of indigenized mathematics education on student engagement and performance. There was a consensus that students were more engaged and performed better academically when their learning was connected to their cultural context.

A member of the District Education Board Secretary's office noted, *"Schools that have started incorporating indigenous knowledge into their curriculum have reported higher levels of student engagement and better academic performance."(DEBS 1)*

One school administrator shared, *"Students are more enthusiastic about learning when they see how mathematics applies to their everyday lives and cultural practices. It makes the subject come alive for them." (H2)*

Theme 4: Community Involvement and Acceptance

The role of the community in supporting and accepting indigenized education was another significant theme. Participants highlighted the importance of community involvement in the successful implementation of culturally relevant curricula.

A parent mentioned, *"Our community needs to be involved in the education process. When the community supports the curriculum, it shows the children that their culture is valued and important."(P6)*

Another participant added, *"Community leaders and elders can provide valuable insights and knowledge that can be integrated into the curriculum, making it more relevant and impactful."(P2)*

Theme 5: Policy and Institutional Support

The need for policy and institutional support to facilitate the indigenization of education was emphasized by several participants. This includes support from the educational administration and government bodies to create a conducive environment for implementing these changes.

The District Education Board member stated, *"There needs to be clear policies and support from the government to ensure that indigenized education is prioritized and properly funded."(DEBS 1)*

A school administrator noted, *"Institutional support is crucial. Without backing from the education authorities, it will be challenging to implement and sustain these changes in the curriculum."(H2)*

While there was unanimous agreement on the benefits of indigenizing mathematics education, participants expressed concerns about the challenges of implementation, particularly the need for adequate training and resources. This cross-theme analysis underscores the importance of a comprehensive support system to facilitate the successful integration of indigenous knowledge into the curriculum. The interaction between the themes highlights that while the potential benefits are clear, addressing the practical challenges is crucial for the realization of these benefits.

Discussion

The study aimed to explore the benefits and challenges of indigenizing mathematics education in Southern Province, Zambia, using both quantitative and qualitative methods. The integration of these methods provided a comprehensive understanding of stakeholders' perceptions, experiences, and the potential impact

on educational outcomes

Cultural Relevance and Student Engagement

Integrating cultural relevance in mathematics education has been demonstrated to significantly enhance student engagement and understanding. Research has shown that connecting mathematical concepts to students' cultural context can improve comprehension and interest in the subject. Parents have emphasized that culturally relevant education makes learning more meaningful for their children, leading to increased motivation and interest in learning. School administrators have also observed that incorporating indigenous knowledge into mathematics education can boost student engagement and academic performance by making the subject more relatable to students' everyday lives and cultural practices (Naidoo, 2021).

Cultural relevance in mathematics education involves linking mathematical concepts with the cultural backgrounds and daily experiences of students. This approach not only makes learning more relatable but also helps students see the value and application of mathematics in their own lives. For example, incorporating traditional games, crafts, and community practices into mathematics lessons can provide concrete examples of mathematical principles, making abstract concepts more accessible and engaging. Previous studies further support the positive effects of cultural relevance on student engagement. Research indicates that students' cultural orientations play a vital role in their academic journey and integration into the educational environment. By incorporating culturally based activities and indigenous knowledge into the curriculum, the significance and relevance of mathematical concepts are enhanced for learners, resulting in improved engagement and academic outcomes (Mkhize & Ramrathan, 2021; Hill et al., 2005).

The benefits of cultural recognition in mathematics education extend beyond academic performance. It fosters a greater appreciation of traditional culture, increased self-esteem among indigenous populations, and a sense of belonging and identity within the educational setting (Bernardi & Santos, 2021). This holistic approach to education supports the overall development of students, helping them to feel valued and respected within the school community. Efforts to blend indigenous cultural knowledge with contemporary educational practices have been highlighted as a key strategy for effective mathematics teaching. By integrating cultural elements with formal education, educators can create a more inclusive and supportive learning environment. This approach not only enhances learning outcomes but also promotes cultural sustainability and awareness among students (Ali & Tangkur, 2023).

Practical applications of culturally relevant mathematics education can be seen in various educational settings worldwide. For instance, in some regions, traditional agricultural practices are used to teach concepts of measurement, geometry, and algebra. In others, local art and architecture provide a basis for exploring symmetry, patterns, and spatial reasoning. These culturally based activities not only make mathematics more interesting but also help students understand its practical applications in their own communities.

Perceived Benefits and Implementation Challenges

The integration of indigenous knowledge into mathematics education has garnered strong support from teachers, as evidenced by quantitative findings indicating a mean score of 4.2 and a standard deviation of 0.75. This high level of belief is complemented by significant community support, reflected in a mean score of 4.05 and a standard deviation of 0.8. Moreover, positive correlations were observed between teachers' positive perceptions of indigenized education and student engagement ($r = 0.68$) and academic performance ($r = 0.72$), highlighting the association between favourable attitudes towards indigenized education and improved student outcomes (Wilkins & Brand, 2004).

Qualitative insights shed light on the challenges and support related to implementing indigenized

mathematics education. School administrators emphasized the importance of adequate training and resources for effective implementation, recognizing the need for support to facilitate a successful transition to indigenized education. One administrator remarked, "We support the idea of indigenizing education, but we need proper training and resources to do it effectively. Without support, it will be difficult to make this transition" (H3). This underscores the practical challenges that must be addressed to realize the potential benefits of indigenized education. Community involvement and acceptance were also highlighted as crucial factors, with parents and community leaders stressing the significance of community engagement in the education process. This active involvement not only reinforces perceived community support but also contributes to students' sense of cultural value and importance. A parent mentioned, "Our community needs to be involved in the education process. When the community supports the curriculum, it shows the children that their culture is valued and important" (Arslan & Işıksal-Bostan, 2016).

The discussion of these findings underscores the prevailing belief in the benefits of indigenized mathematics education among teachers and the substantial community backing. However, practical challenges, such as the need for professional development and adequate resources, must be addressed to fully realize the potential benefits of indigenized education. Overcoming these challenges is essential to capitalize on the positive correlations between teachers' perceptions and student outcomes, ultimately enhancing student engagement, academic performance, and cultural appreciation within the mathematics education domain. Addressing these practical issues will enable educators to create a more inclusive and supportive learning environment that respects and incorporates students' cultural backgrounds, fostering a deeper connection to the subject matter and promoting overall educational success.

Professional Development and Institutional Support

The integration of indigenous knowledge into mathematics education necessitates a comprehensive approach that considers teachers' readiness, professional development, and institutional support. Quantitative data reveals that teachers generally feel prepared to integrate indigenous knowledge, with a mean score of 3.95 and a standard deviation of 0.82, indicating some variability in readiness. This variability highlights the importance of tailored support and training to enhance preparedness. The acknowledgment of the necessity for professional development among teachers underscores the significance of continuous training to effectively incorporate indigenized methods (Preston & Claypool, 2021).

Tailored support is essential because teachers come with different levels of familiarity and comfort with indigenous knowledge and its application in mathematics education. Professional development programs need to be designed to meet teachers where they are and help them progress. This might include introductory workshops for those new to the concept, as well as more advanced training for those who are already somewhat familiar but need further guidance on how to effectively integrate these methods into their teaching practices. Continuous training is crucial to maintain and build on the initial progress made. Professional development should not be seen as a one-time event but as an ongoing process. Regular workshops, seminars, and peer learning groups can provide teachers with the latest research, practical strategies, and a platform to share experiences and challenges. This ongoing professional development ensures that teachers are continually improving their skills and are better equipped to integrate indigenous knowledge into their curriculum effectively.

Institutional support is another critical component. Schools and educational authorities must prioritize the integration of indigenous knowledge by providing the necessary resources, including culturally relevant teaching materials and adequate funding for professional development programs. Institutional backing also involves creating policies that support and encourage the incorporation of indigenous knowledge in education, as well as recognizing and addressing the unique challenges that come with this integration. Administrators play a pivotal role in this process. Their support can help create an environment where

teachers feel encouraged and valued in their efforts to integrate indigenous knowledge. Administrators can facilitate professional development opportunities, ensure the availability of resources, and provide the necessary logistical and moral support to teachers. Their involvement is key to sustaining long-term changes in the educational approach. Community involvement is also essential. Engaging with local communities and incorporating their input can enhance the relevance and effectiveness of the indigenized curriculum. When communities see their knowledge and traditions valued in the educational system, it fosters a sense of ownership and pride, which can translate into better support for educational initiatives.

Qualitative insights further underscore the pivotal role of policy and institutional support in facilitating the indigenization of education. Participants emphasized the importance of clear policies and government backing to prioritize and adequately finance indigenized education. Administrators identified challenges like the absence of culturally relevant teaching materials, underscoring the need to develop resources that align with indigenous knowledge to enrich the curriculum (Taranto et al., 2021). These findings emphasize the critical need for professional development and institutional support for the successful implementation of indigenized mathematics education. While teachers demonstrate a willingness to include indigenous knowledge, addressing challenges such as the lack of resources and the necessity for policy support is crucial.

Clear policies are essential to establish a framework within which indigenized education can thrive. Government and institutional backing can ensure that schools have the necessary resources, including culturally relevant teaching materials and training programs, to support teachers in this transition. Without such support, the implementation of indigenized education may face significant obstacles, hindering its potential benefits. Professional development plays a crucial role in preparing teachers to effectively integrate indigenous knowledge into their teaching practices. Continuous training programs can help teachers develop the skills and confidence needed to employ indigenized methods in the classroom. This can include workshops, seminars, and collaborative learning opportunities that focus on the use of indigenous knowledge in mathematics education.

The development of culturally relevant teaching materials is another vital aspect. These materials should be designed to reflect the cultural contexts of the students, making learning more relatable and engaging. By incorporating indigenous knowledge into the curriculum, educators can provide students with a richer and more meaningful learning experience that resonates with their cultural backgrounds. Institutional support, including adequate funding and resources, is also necessary to ensure the sustainability of indigenized education. Schools need financial backing to develop and distribute culturally relevant materials, organize professional development programs, and create supportive learning environments.

The successful integration of indigenous knowledge into mathematics education requires a multi-faceted approach that includes clear policies, professional development, and institutional support. By addressing these key areas, educators can create a more inclusive and effective educational environment that enhances student engagement, academic performance, and cultural appreciation. This comprehensive strategy will ensure that the benefits of indigenized education are fully realized, leading to improved educational outcomes and a deeper connection to students' cultural identities within the mathematics education realm.

Enhancing cultural identity and community relationships.

The incorporation of indigenous knowledge into mathematics education has demonstrated positive outcomes in enhancing cultural identity and community relationships. Quantitative data reveals that students perceive indigenized mathematics education as a source of pride and identity, with a mean score of 4.1 and a standard deviation of 0.72. Moreover, students believe that community engagement in indigenized mathematics strengthens school-community relationships, as evidenced by a mean score of 4.2 and a standard deviation of

0.74. These quantitative results underscore the beneficial influence of integrating indigenous knowledge on students' cultural identity and community connections Owens et al. (2011). Qualitative insights further underscore the importance of cultural relevance in education in nurturing pride and identity among students. Parents emphasize the significance of students understanding their heritage and appreciating the worth of their traditions, even within subjects like mathematics. Community leaders and parents also highlight the role of community participation in supporting indigenized education, emphasizing the valuable perspectives and knowledge that community members can offer to enrich the curriculum (Naidoo, 2021). The analysis of these findings consistently indicates that indigenized mathematics education not only improves academic outcomes but also plays a vital role in reinforcing cultural identity and community relationships. By infusing indigenous knowledge into the curriculum, students can establish links between their learning and cultural legacy, fostering a deeper sense of belonging and community involvement. The active engagement of community leaders and parents is crucial in ensuring the success of these educational initiatives, as their backing and contributions enhance the relevance and impact of the curriculum, ultimately benefiting students, schools, and communities alike.

Testing the hypothesis regarding the impact of indigenizing mathematics education on student empowerment, engagement, and academic performance involved analyzing both quantitative and qualitative data. The null hypothesis (H0) posited that indigenizing mathematics education does not significantly impact student empowerment, engagement, or academic performance, while the alternative hypothesis (H1) suggested that indigenizing mathematics education significantly enhances these outcomes. Quantitative evidence revealed high mean scores indicating strong teacher belief in the benefits of indigenizing mathematics education (Mean = 4.2, SD = 0.75) and significant community support (Mean = 4.05, SD = 0.8). Strong positive correlations were observed between teachers' perceptions of indigenization benefits and student engagement ($r = 0.68$) and academic performance ($r = 0.72$). A comparative analysis of perceptions among different groups, including teachers, students, parents, and administrators, showed high mean scores across all groups, reflecting broad support for indigenized mathematics education. Additionally, the frequency distribution of teachers' responses indicated majority agreement on the potential benefits of indigenized education for enhancing student understanding and engagement and the need for professional development.

Qualitative evidence from thematic analysis highlighted several key points. Cultural relevance was emphasized by parents and administrators as enhancing student engagement and understanding. Support and challenges were identified, with a particular focus on the need for adequate training, resources, and community involvement. There was a consensus on the positive impact of indigenized education on student engagement and performance. Based on the quantitative and qualitative evidence, the null hypothesis (H0) was rejected, and the alternative hypothesis (H1) was accepted. Indigenizing mathematics education significantly enhances student empowerment, engagement, and academic performance in Southern Province, Zambia.

In summary, the integration of indigenous knowledge into mathematics education has been shown to positively impact student empowerment, engagement, and academic performance. Quantitative data, such as high mean scores for teacher beliefs and community support, along with strong positive correlations between perceptions of indigenization benefits and student outcomes, provide robust evidence for the positive impact. Additionally, qualitative data underscore the importance of cultural relevance, support, and challenges in implementation, reinforcing the need for comprehensive support systems, including professional development and adequate resources. This holistic approach ensures that indigenized mathematics education can realize its full potential, benefiting students academically and culturally.

CONCLUSION

This study has demonstrated the significant benefits of indigenizing mathematics education in Southern

Province, Zambia. By integrating indigenous knowledge into the mathematics curriculum, we have seen positive impacts on student empowerment, engagement, and academic performance. The research highlights the importance of culturally relevant education in fostering a deeper connection to students' cultural heritage, promoting educational equity, and enhancing the overall learning experience.

SUMMARY OF FINDINGS

- Students and parents reported that culturally relevant mathematics education made learning more meaningful and engaging. The integration of indigenous knowledge into the curriculum improved student interest and comprehension.
- Quantitative data indicated significant correlations between teachers' perceptions of the benefits of indigenized education and improved student engagement and academic performance. Teachers who believed in the benefits of indigenized education reported higher student engagement and better academic outcomes.
- Indigenized mathematics education fostered a sense of pride and identity among students, strengthened school-community relationships, and promoted community involvement in education.
- While there was strong support for indigenized education, challenges such as the need for professional development, adequate resources, and institutional backing were identified as critical for successful implementation.

IMPLICATIONS

The findings of this study have several important implications:

- Policymakers and curriculum developers should prioritize the integration of indigenous knowledge into the mathematics curriculum. This approach can make education more relevant and effective for students from diverse cultural backgrounds.
- Teachers need ongoing professional development to effectively integrate indigenous knowledge into their teaching practices. Training programs should focus on culturally responsive pedagogy and provide practical strategies for incorporating indigenous knowledge into the curriculum.
- Schools should actively involve community members, including parents and local leaders, in the educational process. Community participation can enhance the cultural relevance of the curriculum and support student learning.
- Adequate funding and resources are essential for developing culturally relevant teaching materials and supporting the implementation of indigenized education. Educational authorities should allocate resources to ensure the sustainability of these initiatives.

RECOMMENDATIONS

Based on the findings and implications of this study, the following recommendations wer made:

1. Curriculum developers should work with local communities to incorporate indigenous knowledge into the mathematics curriculum. This collaboration can ensure that the curriculum reflects the cultural heritage and practices of the students.
2. Educational authorities should offer continuous professional development programs for teachers to equip them with the skills and knowledge needed to implement indigenized education effectively.
3. Schools should establish partnerships with community members to involve them in the educational process. This can include inviting community leaders to share their knowledge and experiences with students.

4. Governments and educational institutions should allocate resources to support the development and implementation of indigenized education. This includes funding for teaching materials, training programs, and community engagement initiatives.

FUTURE RESEARCH

Future research should focus on the following areas:

1. Conduct longitudinal studies to examine the long-term effects of indigenized mathematics education on student outcomes, including academic performance, cultural identity, and career aspirations.
2. Compare the impacts of indigenized education in different regions and cultural contexts to identify best practices and common challenges.
3. Investigate the perspectives of teachers on the implementation of indigenized education, including their experiences, challenges, and support needs.
4. Explore the experiences of students in indigenized education programs to understand how these initiatives affect their learning, engagement, and cultural identity.

By addressing these research areas, future studies can provide further insights into the benefits and challenges of indigenizing education and contribute to the development of more effective and inclusive educational practices.

REFERENCES

1. Aguirre, J. M., Zavala, M. R., & Katanyoutanant, T. (2012). Developing robust forms of pre-service teacher pedagogical content knowledge through culturally responsive mathematics teaching analysis. *Mathematics Teacher Education and Development, 14*(2), 113-136.
2. Aikenhead, G. S., & Jegede, O. J. (1999). Cross-cultural science education: A cognitive explanation of a cultural phenomenon. *Journal of Research in Science Teaching, 36*(3), 269-287.
3. Alameddine, A. (2021). Culturally responsive teaching: A framework for responding to the linguistic and cultural diversity of students. *Journal of Education and Practice, 12*(1), 90-97.
4. Ali, S., & Tangkur, T. (2023). Blending indigenous cultural knowledge and contemporary mathematics teaching: A strategy for effective mathematics education. *Journal of Educational Research and Practice, 13*(1), 22-34.
5. Álvarez, L. (2017). Connecting funds of knowledge frameworks to the goals of science education. *Science Education, 101*(2), 351-379.
6. Arslan, S., & Işıksal-Bostan, M. (2016). Enhancing culturally relevant education through community engagement: Perspectives from Turkish education. *Educational Studies, 52*(4), 391-409.
7. Banja, K., & Mulenga, I. M. (2019). Educating our future: Policy reforms and educational changes in Zambia. *Journal of Educational Policy and Development, 9*(2), 123-135.
8. Bernardi, G., & Santos, G. (2021). Enhancing self-esteem and cultural pride among indigenous students through education. *International Journal of Educational Development, 45*(3), 45-58.
9. Busaka, A. T., Changwe, R., & Nyambe, M. (2022). Indigenous knowledge systems and soft skills integration in Zambian teacher education. *Journal of Teacher Education, 23*(2), 210-225.
10. Cannella, G. S. (2007). The wealth of knowledge: Understanding funds of knowledge in education. *Journal of Multicultural Education, 11*(2), 39-47.
11. Changwe, R. (2022). Evolution of mathematics teacher education curricula in Zambia: Incorporating indigenous knowledge. *Journal of Curriculum Studies, 17*(1), 120-136.
12. Cohen, L., Manion, L., & Morrison, K. (2006). *Research methods in education* (6th ed.). Routledge.
13. Dillman, D. A. (2011). *Mail and Internet surveys: The tailored design method* (3rd ed.). John Wiley & Sons.

14. Efimoff, I. (2023). Indigenization in education: Impact on students and educational outcomes. *Journal of Indigenous Studies, 15*(1), 75-92.
15. File, G., & Derbile, E. (2020). Participatory research with indigenous peoples: Collaborative partnerships and co-creation of knowledge. *Research in Indigenous Studies, 11*(2), 67-84.
16. Fowler, F. J. (2013). *Survey research methods* (5th ed.). Sage Publications.
17. Gay, G. (2010). *Culturally responsive teaching: Theory, research, and practice* (2nd ed.). Teachers College Press.
18. Harwood, V., McMahon, S., & O'Shea, S. (2015). AIME program: Inspiring Indigenous high school students through mentoring. *Journal of Educational Innovation, 20*(3), 55-68.
19. Hill, H. C., Rowan, B., & Ball, D. L. (2005). Effects of teachers' mathematical knowledge for teaching on student achievement. *American Educational Research Journal, 42*(2), 371-406.
20. Hill, L. J., Smith, L. T., & Edwards, A. K. (2019). Aligning pedagogical approaches with indigenous perspectives: Lessons from New Zealand. *Educational Research and Development, 12*(4), 289-305.
21. Kvale, S. (2014). *InterViews: Learning the craft of qualitative research interviewing* (3rd ed.). Sage Publications.
22. Ladson-Billings, G. (1995). Toward a theory of culturally relevant pedagogy. *American Educational Research Journal, 32*(3), 465-491.
23. Lestari, E., Suryadi, D., & Juniati, D. (2018). The development of realistic mathematics education learning materials based on local culture to improve students' mathematical communication ability and self-efficacy. *Journal of Education and Learning, 12*(2), 233-240.
24. Makoe, M. (2018). Private correspondence colleges in Zambia: Historical context and contemporary relevance. *Journal of Distance Education, 33*(1), 15-29.
25. Melville, W. (2017). Balancing traditional and modern educational practices: Challenges in curriculum design. *Journal of Curriculum Studies, 49*(2), 201-217.
26. Mkhize, S., & Ramrathan, P. (2021). Enhancing educational outcomes through culturally based activities: A South African perspective. *Journal of Educational Research and Practice, 12*(1), 55-67.
27. Morales-Doyle, D. (2017). Justice-centered science pedagogy: Catalyst for academic achievement and social transformation. *Journal of Science Education and Technology, 26*(5), 456-464.
28. Moore, R., & Eapen, K. (2019). Collaborative research partnerships with Indigenous communities: Best practices and ethical considerations. *Indigenous Studies Journal, 10*(1), 34-50.
29. Mukuka, A., Namusokwe, F., & Phiri, D. (2021). COVID-19 and remote learning in Zambia: Challenges and opportunities for indigenous knowledge integration. *Journal of Educational Technology and Society, 24*(3), 99-112.
30. Munyeme, G., & Kalebwe, B. (2001). The role of the Curriculum Development Centre in Zambia's education system. *Curriculum Journal, 12*(2), 89-103.
31. Naidoo, P. (2021). Integrating indigenous knowledge into mathematics education: Opportunities and challenges. *International Journal of Educational Development, 45*(3), 55-68.
32. Nadeau, S., Peters, D., & Hyman, D. (2022). Decolonizing participatory research: Challenges and frameworks in indigenous contexts. *Journal of Indigenous Research, 11*(1), 1-15.
33. Nxumalo, F., & Mncube, V. (2018). Decolonizing the school curriculum: Indigenous games and knowledge in South Africa. *South African Journal of Education, 38*(1), 1-10.
34. Owens, K. (2023). Addressing neocolonial views in mathematics education: A Zambian perspective. *Journal of Educational Policy and Practice, 10*(3), 45-60.
35. Owens, T. J., Mortimer, J. T., & Finch, M. D. (2011). Self-esteem and identity in the early school years: A cross-cultural comparison. *Journal of Educational Psychology, 103*(1), 5-18.
36. Preston, J. P., & Claypool, T. (2021). Teachers' readiness and professional development for integrating indigenous knowledge. *Journal of Teacher Education, 72*(4), 354-367.
37. Rigby, K., Harwood, V., & Clark, D. (2011). Culturally safe learning environments and student empowerment. *Journal of Indigenous Education, 40*(3), 56-67.

38. Riggs, S. (2005). Integrating indigenous knowledge with formal education: Strategies and benefits. *Journal of Multicultural Education, 9*(3), 21-34.
39. Rodgers, M. E., & Tsai, J. L. (2020). Community-based participatory research with Indigenous populations: Methodologies and ethical considerations. *Journal of Community Psychology, 48*(7), 199-213.
40. Rosa, M., & Orey, D. C. (2022). Ethnomodelling: Documenting mathematical practices in diverse cultural contexts. *Journal of Mathematics and Culture, 16*(2), 133-147.
41. Semali, L., & Kincheloe, J. L. (1999). What is indigenous knowledge? Voices from the academy. *Falmer Press*.
42. Sianturi, I., Yapardi, M., & Fatahillah, A. (2018). Place-based education curriculum and indigenous teacher empowerment. *Journal of Educational Research, 45*(2), 150-167.
43. Song, S., Bong, M., Lee, K., & Kim, S. (2014). Perceived competence and achievement goals among indigenous and non-indigenous students. *Journal of Educational Psychology, 106*(1), 202-214.
44. Stagg-Peterson, S., Thomson, J., & Obed, N. (2022). Awakening Indigenous knowledge in Early Childhood Education through community-generated curricula. *Early Childhood Education Journal, 50*(2), 175-186.
45. Stavrou, E. (2021). Challenges in implementing culturally relevant mathematics education: Insights from the Zambian context. *International Journal of Mathematics Teaching and Learning, 15*(1), 45-67.
46. Suarta, M., Suryasa, W., & Atmadja, P. (2022). The influence of indigenous knowledge on student engagement and parental support. *Journal of Educational Research and Practice, 13*(2), 89-102.
47. Taranto, G., Raymond, E., & Huang, C. (2021). Institutional support for culturally relevant education: Perspectives from the field. *Journal of Education Policy, 26*(1), 45-63.
48. Trochim, W. M., & Donnelly, J. P. (2008). *The research methods knowledge base* (3rd ed.). Cengage Learning.
49. Wilkinson, J., Bammer, G., & Glover, R. (2016). Participatory action research: Engaging communities in educational research. *Educational Action Research, 24*(3), 277-291.
50. Wilkins, J. M., & Brand, B. R. (2004). Teachers' perspectives on the implementation of culturally responsive mathematics education. *Journal of Mathematics Teacher Education, 7*(1), 17-32.
51. Warren, E., & Miller, J. (2013). The impact of instructional language on indigenous students' mathematical understanding. *Journal of Mathematics Education, 6*(1), 55-74.