

Mathematics Teachers' and Learners' Attitudes Towards Indigenizing Pedagogies and Practices in Mathematics Education in Southern Province, Kalomo; Zambia

Kaziya Kadonsi<sup>1</sup>, Kenneth Kapalu Muzata<sup>2</sup>, Magdalene Simalalo<sup>3</sup>

The University of Zambia, Lusaka, Zambia.

DOI: <https://doi.org/10.56293/IJASR.2022.5569>

IJASR 2023

VOLUME 6

ISSUE 5 SEPTEMBER – OCTOBER

ISSN: 2581-7876

**Abstract:** This research explored the attitudes of mathematics teachers and learners towards the incorporation of indigenous pedagogies in mathematics education in Kalomo district of Southern Province, Zambia. Grounded in critical realism and pragmatism, this study employed a Mixed Methods Sequential Explanatory Design involving 343 respondents. The quantitative sample comprised 326 participants, while the qualitative component involves 17 participants.

Data collection methods encompassed questionnaire surveys, interviews, focus group discussions, classroom observations, and document analysis. However, data for this paper was drafted from questionnaires and interviews. Data analysis utilized descriptive statistics and inferential statistics, with validation through a pilot study and reliability assessment using Cronbach's Alpha.

The study revealed a favorable disposition among teachers in Kalomo District towards the incorporation of indigenous teaching methods in mathematics education. This research offers valuable insights into the possibility of indigenizing mathematics pedagogies and practices to enhance educational quality in Zambia. Furthermore, this study underscores the need for curriculum reform, teacher training, collaboration with local communities, and interdisciplinary cooperation to create a well-rounded indigenized mathematics curriculum. The results affirm the global movement towards recognizing diverse knowledge systems in education and the importance of culturally inclusive pedagogies.

**Keywords:** Indigenizing pedagogies, Mathematics education, Teacher training, Collaboration, Interdisciplinary cooperation, culturally relevant education, Cultural identity,

### Introduction

In the realm of education, the quest for inclusivity and cultural relevance has become an ever-more pressing concern. It is a call to action that resonates worldwide but finds particularly poignant expression in the Southern Province of Kalomo, Zambia. In this picturesque region, nestled between the lush banks of the Zambezi River and the vast expanse of the Zambezi Plateau, a profound exploration into the attitudes of mathematics teachers towards and the learners they teach the incorporation of indigenous pedagogies in mathematics education unfolds. This research explored an often-overlooked aspect of educational discourse, one that speaks directly to the heart of cultural identity, inclusivity, and the transformative power of education.

For years, mathematics education has been a global endeavor, characterized by standardized curricula and universally accepted pedagogical approaches. However, as we explored deeper into the unique cultural mosaic of the schools in Kalomo District, the need for a mathematics curriculum that is deeply rooted in local cultural perspectives becomes strikingly apparent. This article embarks on a journey through the attitudes of mathematics teachers, towards the integration of indigenous knowledge, cultural perspectives, and traditional practices into the teaching of mathematics—an educational concept known as "indigenizing mathematics education."

The Southern Province, and specifically Kalomo district where this study was conducted, is a region steeped in diverse traditions, languages, and indigenous knowledge systems. Against this backdrop, the mathematics classroom has the potential to be a bridge between abstract mathematical concepts and the rich tapestry of local cultures. Yet, for such

an integration to be successful, it hinges upon the attitudes and beliefs of the educators themselves—those mathematics teachers who serve as the catalysts of this transformative process.

This study undertakes a comprehensive examination of these attitudes. Drawing upon a Mixed Methods Sequential Explanatory Design, it engages with 343 participants, including 55 mathematics teachers, 271 Grade 12 pupils, 10 community members, 1 representative from the District Education Board Secretary's office, and 6 school administrators. Through the lens of both quantitative and qualitative inquiry, it aims to uncover the subtle nuances, the challenges, and the aspirations that shape the landscape of mathematics education in Kalomo.

As we embark on this exploration, we recognize that teachers play a pivotal role in shaping the educational experiences and achievements of students. Their attitudes towards indigenization are critical, as they can either propel or hinder the successful implementation of indigenized teaching methods. The findings of this research hold the promise of not only shedding light on the attitudes of mathematics educators in Zambia but also contributing to the broader discourse on culturally relevant education, with implications that resonate far beyond this region.

Mukuka et al., (2021) argues that Mathematics education in Zambia has been a topic of concern due to the poor performance of students in the subject. Despite being a compulsory subject, many students struggle with mathematics, leading to low achievement levels. Similarly, Alibraheim (2021) argues that one factor that has been identified as influencing students' performance in mathematics is their attitude towards the subject. Negative attitudes towards mathematics have been reported by students in Zambia, which contributes to their poor performance. Therefore, addressing students' attitudes and fostering a positive attitude towards mathematics is crucial for improving their performance.

Changwe, (2022) argues that the preparation of mathematics teachers in Zambia has also been identified as a contributing factor to the challenges faced in mathematics education. The curriculum for mathematics teacher education has been found to be loosely linked to the expectations of the teaching profession, leading to a mismatch between what student teachers are taught and what they are expected to teach in schools. This misalignment affects the quality of mathematics instruction in secondary schools.

Mathematics education in Zambia faces several challenges, including poor performance, negative attitudes towards the subject, and a mismatch between teacher education curricula and teaching expectations. These issues call for a comprehensive and contextually appropriate approach to mathematics education, which includes addressing students' attitudes, incorporating indigenous approaches, and aligning teacher education curricula with teaching expectations.

### Background of the study

Mathematics education plays a crucial role in shaping students' understanding and engagement with the subject. The pedagogical approaches and practices employed by mathematics teachers have a significant impact on students' attitudes and learning outcomes (Jao et al., 2018). However, there is a need to explore and understand the attitudes of mathematics teachers towards indigenizing pedagogies and practices in mathematics education, particularly in the Southern Province of Kalomo, Zambia.

Indigenizing pedagogies and practices involve incorporating local cultural knowledge, values, and perspectives into the teaching and learning process (Bhattarai, 2021). This approach recognizes the importance of cultural diversity and aims to make mathematics education more relevant and meaningful to students (Leonard & Moore, 2014). It is essential to investigate the attitudes of mathematics teachers towards indigenizing pedagogies and practices in order to promote culturally responsive teaching and enhance students' engagement and achievement in mathematics.

Research conducted in other contexts has highlighted the challenges and adaptations required in implementing practice-based pedagogies in mathematics and science education (Jao et al., 2018). These challenges include understanding the complexities of teaching and developing novice teachers' pedagogies of practice. By examining the experiences and practices of mathematics, valuable insights can be gained into the implementation of indigenizing pedagogies in mathematics education.

Furthermore, studies have shown that students' attitudes towards mathematics are crucial factors influencing their achievement in the subject. Therefore, understanding mathematics teachers' attitudes towards indigenizing pedagogies and practices can provide valuable insights into the potential impact on students' attitudes and learning outcomes. Likewise, learners' attitudes are likely to impact on the way they learn. Investigating mathematics teachers' their learners' attitudes towards indigenizing pedagogies and practices in mathematics education in the Southern Province of Kalomo, Zambia, can provide valuable insights into the potential for culturally responsive teaching and learning. By understanding the challenges, adaptations, and opportunities, strategies can be developed to enhance mathematics education and promote students' engagement and achievement in the subject.

In the context of Zambia, it is essential to consider the specific challenges and opportunities for indigenizing pedagogies and practices in mathematics education. This includes examining the current curriculum trends, gender perspectives, and the incorporation of indigenous knowledge (Bhattarai, 2021). By critically appraising the curriculum and considering the experiences and perspectives of mathematics teachers, a comprehensive understanding of the potential for indigenizing pedagogies in mathematics education can be developed.

In Zambia, particularly in the Southern Province and Kalomo, the state of mathematics education is influenced by various factors. One of the recent challenges faced in mathematics education is the impact of the COVID-19 pandemic and the subsequent school closures. A study by Mukuka et al. (2021) investigated the experiences of secondary school students with remote learning during the COVID-19 school closure. The study highlighted the challenges associated with remote learning, including limited access to resources and difficulties in understanding mathematical concepts without face-to-face interaction. These findings have implications for mathematics education in the region, as they highlight the need for effective strategies to support remote learning and address the learning gaps caused by the pandemic.

In terms of curriculum frameworks, the integration of mathematics and science education has been a focus in Zambia. Huntley (2018) discusses the design and implementation of a framework for defining integrated mathematics and science education. The framework aims to provide clarity and coherence in the teaching of mathematics and science, promoting interdisciplinary connections and real-world applications. This integrated approach to mathematics education can enhance students' understanding and engagement with the subject. However, there are also challenges specific to mathematics education in Zambia. A study by Malambo et al. (2018) examined the case of Zambian mathematics education students and identified issues within the education system. The study highlighted issues such as inadequate teacher training, limited resources, and a lack of support for students with learning difficulties. These challenges can impact the quality of mathematics education and hinder students' learning outcomes.

The state of mathematics education in Zambia, particularly in the Southern Province and Kalomo, is influenced by various factors. The COVID-19 pandemic has posed challenges for remote learning in mathematics education. The integration of mathematics and science education has been a focus in curriculum frameworks, aiming to promote interdisciplinary connections. However, there are also challenges such as inadequate teacher training and limited resources that need to be addressed to improve the quality of mathematics education in the region.

### Statement of the Problem

In the Southern Province of Kalomo, Zambia, there exists a pressing challenge within the realm of mathematics education that warrants immediate attention and thorough exploration. This challenge revolves around the attitudes held by mathematics educators towards the incorporation of indigenous pedagogies into mathematics education. In an era where global educational discourse increasingly underscores the significance of culturally pertinent curricula and teaching methodologies, it is imperative to scrutinize the specific circumstances in Kalomo and gain insight into the prevailing sentiments among mathematics educators regarding this transformative approach.

The crux of the issue under investigation encompasses several facets, necessitating an in-depth examination. The conventional mathematics curriculum in Zambia, akin to many other regions worldwide, predominantly adheres to Western pedagogical paradigms. This curriculum frequently falls short in assimilating indigenous knowledge, cultural perspectives, and traditional practices from the diverse communities of the Southern Province. This gap raises concerns pertaining to the cultural pertinence and accessibility of mathematics education for the local student populace.

The examination of mathematics teachers' attitudes is fundamental to comprehending potential impediments or catalysts to the integration of indigenous knowledge into mathematics instruction. Given the urgency of advancing inclusive and culturally relevant education, this research aspires to offer empirical insights into the attitudes held by mathematics educators in the Southern Province of Kalomo, Zambia, regarding the indigenization of mathematics education.

## Research Hypothesis and Questions

The main objective of this study was to determine teachers and learners' attitudes towards the indigenization of mathematics pedagogies and practices in teaching and learning. The study endeavored to answer the following hypothesis and research questions:

1. Teachers are more likely to possess positive attitudes towards indigenization of mathematics pedagogies and practices compared to their learners
2. Learners are more likely to possess negative attitudes towards indigenization of mathematics pedagogies and practices compared to their teachers

## Research questions

1. What are teachers and learners' attitudes towards indigenization of Mathematics pedagogies and practices?
2. How do teachers and learners describe their perceptions towards the indigenization of mathematics pedagogies and practices?
3. What factors influence the attitudes of teachers and learners towards indigenizing Mathematics?

## LITERATURE REVIEW

### Indigenizing Pedagogies in teaching Mathematics Education

Indigenizing pedagogies in mathematics education is a concept that has gained attention in the field of education. It involves incorporating Indigenous knowledge, perspectives, and ways of learning into the teaching and learning of mathematics. This approach recognizes the importance of cultural relevance and the need to create inclusive and equitable learning environments for Indigenous students. One study by Brant (2014) explores the tensions faced by Indigenous learners in mainstream education and emphasizes the significance of decolonizing education. The author highlights the need for Indigenous students to have their own space and sense of place within the educational system. This aligns with the goal of indigenizing pedagogies, which aims to create educational experiences that are culturally responsive and affirming for Indigenous students.

Another study by Biermann and Townsend-Cross (2008) discusses the challenges and potential solutions for incorporating Indigenous pedagogy into education. The authors highlight the importance of going beyond the classroom and integrating Indigenous pedagogy into various educational settings. This aligns with the idea of indigenizing pedagogies in mathematics education, as it emphasizes the need to incorporate Indigenous ways of knowing and learning into the teaching of mathematics.

The concept of culturally responsive pedagogy is also relevant to indigenizing pedagogies in mathematics education. Boon and Lewthwaite (2015) developed an instrument to measure culturally responsive pedagogy and found that it is a unidimensional latent trait. This suggests that culturally responsive pedagogy can be a key component of indigenizing pedagogies in mathematics education, as it involves adapting teaching practices to meet the cultural and linguistic needs of Indigenous students.

Furthermore, the study by Gillispie (2021) discusses the importance of culturally responsive language and literacy instruction for Native American children. The author emphasizes the need to combine evidence-based reading instruction with cultural-based educational practices. This aligns with the goals of indigenizing pedagogies in mathematics education, as it highlights the importance of integrating Indigenous culture and language into the teaching of mathematics.

Indigenizing pedagogies in mathematics education involves incorporating Indigenous knowledge, perspectives, and ways of learning into the teaching and learning of mathematics. This approach recognizes the importance of cultural relevance and aims to create inclusive and equitable learning environments for Indigenous students. The literature supports the significance of decolonizing education, going beyond the classroom, and integrating culturally responsive pedagogy in order to achieve the goals of indigenizing pedagogies in mathematics education.

### **Teachers' Attitudes towards indigenizing pedagogies in Mathematics Education.**

Teachers' attitudes towards pedagogical approaches, particularly indigenizing pedagogies, are influenced by various factors. One factor that influences teachers' attitudes is their prior knowledge and beliefs about teaching (Watzke, 2007). Teachers' attitudes towards control in the classroom and their instructional goals for daily lessons also play a role in shaping their pedagogical approaches (Watzke, 2007). Additionally, teachers' attitudes towards the integration of migrant students and their cultural understandings can impact their attitudes towards indigenizing pedagogies (Biasutti et al., 2021; Funk & Woodroffe, 2023).

There are studies that explore changes in teachers' attitudes over time. For example, a study found that pre-service teachers' pedagogical beliefs changed over the course of their teacher education program (Biasutti et al., 2021). Another study investigated the impact of presenting communicative traits of writing through cooperative learning on trainee teachers' pedagogical knowledge and attitudes towards a 'traits of writing' approach (Hussien, 2020). The results showed that the intervention had a positive impact on the trainee teachers' pedagogical knowledge and attitudes.

Furthermore, teachers' attitudes towards the implementation of innovative technologies in schools can also influence their pedagogical approaches. Research has shown that teachers' attitudes towards change and their technological-pedagogical content knowledge are positively correlated (Avidov-Ungar and Eshet-Alkalai, 2011). Similarly, teachers' openness to change and their attitudes towards ICT can support pedagogical changes (Blau and Peled, 2012). Positive attitudes to use of technologies can allow access to education (Mwanza, Simalalo, Simui, 2021). Current discourse in education further urges for inclusive pedagogies (Mooka, Siakalima, Simalalo, Muleya, Kaputa, & Simui, 2020; Muzata, 2021), a thought to which this paper is aligned to and possible negative attitudes can influence negatively the way an activity is done (Muzata, Simalalo, Kasonde-Ng'andu, Mahlo, Banja, & Mtonga, 2019), in this case adoption of indigenous methods in teaching mathematics.

Teachers' attitudes towards pedagogical approaches, including indigenizing pedagogies, are influenced by factors such as prior knowledge, beliefs about teaching, attitudes towards control in the classroom, instructional goals, attitudes towards the integration of migrant students, and attitudes towards the implementation of innovative technologies. There are studies that explore changes in teachers' attitudes over time, indicating that attitudes can be influenced and modified through various interventions and experiences. Understanding these factors and changes in attitudes is crucial for promoting effective pedagogical practices and supporting teachers in their professional development.

### **Impact of Cultural Context and Indigenous Knowledge on Mathematics Education**

The cultural context has a significant impact on mathematics education. Several studies have explored the integration of indigenous knowledge into the curriculum to make mathematics more relevant and meaningful for students. One study by Utami et al. (2021) highlights the importance of incorporating indigenous contexts into mathematics education. It suggests that culturally relevant pedagogy can support learning among indigenous students by leveraging their indigenous knowledge, which naturally facilitates understanding and meaningful learning of mathematics.

Similarly, Lestari et al. (2018) discuss the development of learning materials based on realistic mathematics education (RME) with the Malay culture context. This approach aims to improve students' mathematical communication ability and self-efficacy while increasing their knowledge about their culture. The authors argue that integrating the local cultural context into mathematics learning can have positive effects on students' communication skills, motivation, and cultural awareness.

Incorporating indigenous students' values, beliefs, and traditions into mathematics education is also emphasized in the study by (Han, 2019). The author suggests that by incorporating indigenous students' cultural perspectives,

educators can enhance their interest and enjoyment in learning mathematics. This approach not only promotes cultural inclusivity but also helps to make mathematics more engaging and relevant for indigenous students.

Furthermore, the study by Mendrofa et al. (2022) explores mathematics learning based on multicultural education. It argues that integrating multicultural values into mathematics education can optimize learning achievement while fostering awareness, understanding, tolerance, and mutual understanding among students. By inserting various Indonesian cultural content and contexts into learning activities, mathematics education can become more culturally situated and meaningful for students.

Overall, these studies highlight the importance of integrating indigenous knowledge and cultural contexts into mathematics education. By doing so, educators can make mathematics more relevant, engaging, and meaningful for students, particularly those from indigenous or diverse cultural backgrounds.

### **Impact of different pedagogical approaches on student performance and learning outcomes in mathematics**

There is indeed research on the impact of different pedagogical approaches on student performance and learning outcomes in mathematics. Several studies have explored this topic and provided valuable insights. One study by Hardman (2019) reviewed studies conducted between 2008 and 2018 to investigate the impact of using Information and Communication Technologies (ICTs) as teaching tools in mathematics. The findings indicated that student achievement in mathematics can be positively impacted using technology, depending on the pedagogical practices employed by teachers. It was noted that technology alone does not have a significant impact on student attainment. Another study by Verschaffel et al. (2019) focused on meta-cognitively oriented ICT-based learning environments for mathematics. The authors emphasized the need for more research attention to the affective and motivational aspects of mathematics learning. They found that studies investigating the effect of ICT or metacognitive pedagogy on motivational-affective outcomes in mathematics were rare, despite the well-documented problems in this area.

Hall and Miro (2016) conducted a study to investigate the effectiveness of innovative approaches to STEM education, including mathematics, on student achievement and interest in STEM careers. They found that introducing a mathematics-infused engineering and technology education curriculum had a significant positive effect on students' mathematics performance. The students who participated in the curriculum viewed mathematics as more important and interesting compared to the control group.

Nolan (2011) explored the field of mathematics teacher education and the impact of different pedagogical approaches. The study focused on producing more egalitarian classrooms, enhancing pedagogical effectiveness through inquiry-based approaches, and encouraging the development of reflective practitioners. The research aimed to learn from prospective secondary mathematics teachers as they construct and are constructed by official pedagogical discourses embedded in mathematics classrooms.

Tambunan (2021) investigated the impact of mathematical resilience and teacher performance in building mathematical literacy on student learning outcomes in mathematics. The study found that mathematical resilience is related to learning outcomes, and the teacher's performance in building mathematical literacy has a high impact on students' mathematical resilience and, consequently, their learning outcomes.

The research indicates that different pedagogical approaches can have varying impacts on student performance and learning outcomes in mathematics. The use of technology, metacognitive pedagogy, innovative STEM education approaches, and building mathematical resilience and literacy through effective teaching practices have been shown to positively influence student achievement and interest in mathematics.

### **Cross-Cultural Comparative Studies on Pedagogical Approaches in Mathematics Education**

Cross-cultural comparative studies in mathematics education aim to examine the effectiveness of different pedagogical approaches across diverse cultural contexts. These studies shed light on the impact of cultural factors on teaching and learning mathematics and provide insights into how to design more effective instructional strategies. One study by Krain et al. (2014) explores the potential for cross-national pedagogical innovations in international studies. The authors identify three critical themes: culture and cross-national education, collaboration across contexts, and the

need for systematic assessment. This study emphasizes the importance of considering cultural differences when designing pedagogical approaches in mathematics education.

Artemeva and Fox (2011) conducted a study that examined the central pedagogical genre of the undergraduate mathematics lecture classroom across different linguistic, cultural, and educational backgrounds. They found that pervasive pedagogical genres, such as writing out a mathematical narrative on the board while talking aloud, override local differences across contexts of instruction. This suggests that certain pedagogical approaches may be effective across diverse cultural contexts.

Arani (2016) conducted a comparative analysis of a seventh-grade mathematics lesson in Iran and Japan, focusing on the oral teaching tradition in Iran and the literal teaching tradition in Japan. The study employed qualitative research methods, including cross-cultural lesson analysis meetings and semi-structured interviews. The findings highlight the importance of understanding and considering different teaching traditions in different cultural contexts.

Blömeke et al. (2017) conducted a study in the United States that examined the relationship between preschool teacher education and preschool teachers' knowledge in mathematics. The study found that domain-specific opportunities to learn mathematics during teacher education programs were scarce, indicating a need for more focused and culturally responsive mathematics education training for teachers.

Nielsen et al. (2008) discuss culturally responsive mathematics pedagogy through complexivist thinking. They argue for the inclusion of historical approaches that examine specific mathematical knowledge and practices of different cultural groups within a given society. This approach challenges traditional western knowledge structures and aims to empower all students through the development of mathematical understanding.

FitzSimons and Boistrup (2017) propose a model for an educational context that promotes collaboration between vocational subject areas and mathematics. The model emphasizes the re-contextualization of mathematics in vocational settings and highlights the need for mathematics teachers to become familiar with vocational knowledge objects. This approach recognizes the importance of integrating mathematics into real-world contexts and cultural practices.

The cross-cultural comparative studies in mathematics education provide valuable insights into the effectiveness of different pedagogical approaches across diverse cultural contexts. These studies emphasize the importance of considering cultural factors, understanding different teaching traditions, and promoting collaboration between subject areas to enhance mathematics education. By incorporating culturally responsive pedagogical strategies, educators can create more inclusive and effective learning environments for students from diverse cultural backgrounds.

## METHODOLOGY

### Research Design

The research design used in this study was a Mixed Methods Sequential Explanatory Design. Mixed Methods Sequential Explanatory Design is a research approach that combines qualitative and quantitative methods in a sequential manner to provide a comprehensive understanding of a research problem (Ivankova and Creswell, 2006). It involves collecting and analyzing quantitative data first, followed by collecting and analyzing qualitative data to explain or elaborate on the quantitative findings. The integration of both types of data occurs during the interpretation and reporting stages of the research process. This sequential approach allows for a comprehensive exploration of the research questions by combining the strengths of both quantitative and qualitative research methods. Mixed Methods Sequential Explanatory Design offers a valuable approach for researchers to gain a deeper understanding of complex research problems by combining the strengths of qualitative and quantitative methods (McCrudden and McTigue, 2018),

### Study population

The study involved two sample categories; the quantitative sample 326 respondents and 17 participants that participated in the qualitative study. The quantitative sample size consisted of 55 mathematics teachers and 271 Grade

12 pupils, 10 community members, 1 representative from the District Education Board Secretary's office, and 6 school administrators. A selection of community members was included to provide a community perspective on the integration of indigenous pedagogies. The District Education Board Secretary's office was represented to offer insights into the institutional perspective. School administrators were included to understand the viewpoint of those responsible for educational administration at the school level. The participants' characteristics and roles were diverse, to ensure that the study captures a broad range of perspectives related to indigenous mathematics education.

### Data collection methods

Data collection methods used in this study encompass a variety of approaches to gather rich and comprehensive data. Lewis (2015) argues that data collection methods are an essential component of research, as they determine how data is gathered and provide the basis for analysis and interpretation. Quantitative data was collected through structured questionnaire surveys administered to mathematics teachers and Grade 12 pupils. These surveys included closed-ended questions to quantify participants' perceptions, experiences, and attitudes toward indigenous pedagogies.

Qualitative data was gathered through in-depth interviews with community members, the DEBS representative, and school administrators. These semi-structured interviews allowed for open-ended discussions and exploration of participants' perspectives. Focus group discussions were conducted with selected participants to facilitate group dynamics and elicit collective insights. Observations of mathematics classes were carried out to assess the practical implementation of indigenous pedagogies and to observe the level of student engagement and participation in these classes. Relevant documents, including curriculum materials, policy documents, and educational resources were analyzed to provide contextual information and support the interpretation of findings.

### Data analysis

Zhang and Ramos (2023) contend that data analysis in a quantitative study involves the systematic examination and interpretation of numerical data collected during the research process. It aims to uncover patterns, relationships, and trends within the data to answer research questions or test hypotheses. Data analysis involves systematic procedures to make sense of the collected data. The quantitative data from the surveys was subjected to descriptive statistical analysis. This involved calculating measures such as mean, standard deviation, and frequency distributions to summarize and interpret quantitative results. Various statistical tests such as t-tests, ANOVA, correlation analysis, and regression analysis were used to analyze quantitative data.

The study used thematic analysis to analyze the qualitative data. Reeping et. al (2019) states that thematic analysis is a commonly used approach in qualitative data analysis, which involves identifying patterns, themes, and categories within the data. This process involved identifying recurring themes, patterns, and narratives within the qualitative data, allowing for a deeper understanding of participants' perspectives and experiences.

### Credibility, reliability, and trustworthiness

Creswell and Plano (2017), argues that credibility, reliability, and trustworthiness stand as paramount considerations when evaluating the quality and validity of data derived from a mixed methods study. Credibility, at its core, pertains to the degree to which the data can be deemed believable and authentic. In the context of this study, credibility received a significant boost through the deliberate utilization of multiple data sources and varied research methods, thereby establishing a triangulation of findings that came from different sources. By drawing from diverse perspectives and sources, the study succeeded in achieving convergence and consistency in the findings, thereby elevating the overall credibility of the study.

Johnson and Onwuegbuzie (2004) contends that trustworthiness, on the other hand, encompasses the concept of the data's integrity and dependability. Within the confines of this study, trustworthiness was bolstered through transparency and reflexivity.

Tashakkori and Teddlie (2010) argues that reflexivity, is an integral component of trustworthiness, referring to the researcher's conscientious recognition of their personal biases, presumptions, and vantage points that could potentially exert influence on the research process. The researcher actively engaged in an ongoing practice of self-reflection and



critical self-awareness to ensure that the inherent biases did not exert undue sway over the data collection and analysis phases. This approach bolstered the study's trustworthiness by acknowledging and addressing potential sources of bias.

Morse (2015) emphasizes the importance of transparency in research, asserting that it plays a crucial role in establishing the credibility, reliability, and trustworthiness of data. To achieve transparency, researchers should offer clear and thorough explanations of their research design, data collection methods, and analytical approaches. This transparency allows readers to assess the study's rigor and validity, ultimately enhancing the trustworthiness of the data.

**Ethical considerations**

Ethical considerations play a pivotal role in every stage of this research. Participants were provided with clear, written information about the study's purpose, procedures, potential risks, and benefits. They were requested to provide voluntary, informed consent before participating. Participants' identities were protected through the use of pseudonyms, and all data were securely stored to ensure confidentiality.

**PRESENTATION OF RESULTS**

The results of this study have been presented sequentially starting with the quantitative phase results and ending with the qualitative phase findings. The research questions aided the order of presentation. Thus, sub titles adapted from the research questions have been used in the presentation of the results.

The attitudes of teachers of mathematics in Zambia towards indigenizing mathematics pedagogies and practices

**Table 1: shows the views of teachers of mathematics on the indigenization of the pedagogies and practices in teaching mathematics:**

Descriptive Statistics		N	Mean
1	I am familiar with the concept of indigenizing mathematics pedagogies and practices	55	3.44
2	Indigenizing mathematics pedagogies and practices in schools in Zambia is very important	55	3.95
3	I am willing to incorporate indigenous knowledge and practices into my mathematics lessons	55	4.15
4	Indigenizing mathematics pedagogies and practices can enhance students' cultural relevance and engagement in the subject	55	4.05
5	Integrating indigenous mathematical knowledge can improve students' understanding and appreciation of the subject	55	4.13
6	I believe that indigenizing mathematics pedagogies and practices can contribute to students' academic achievement	55	3.98
7	Adopting indigenous perspectives in mathematics teaching can promote cultural diversity and inclusivity in the classroom	55	3.98
8	Incorporating indigenous mathematical knowledge can help students connect mathematics to their daily lives and experiences.	55	4.2
9	Indigenizing mathematics pedagogies and practices can enhance students' motivation and interest in learning mathematics	55	4.25
10	Including indigenous perspectives in mathematics teaching can foster a sense of pride and cultural identity among students.	55	4.00
11	The current mathematics curriculum in Zambia adequately reflects the cultural and historical context of the country	55	2.98

12	The current mathematics curriculum in Zambia adequately prepares students for the demands of the 21st century.	55	3.62
<b>Grand Mean</b>		<b>55</b>	<b>3.894167</b>

The study's findings indicate that respondents had a moderate level of familiarity with the concept of indigenizing mathematics pedagogies and practices, with an average score of 3.44. They strongly believed in the importance of indigenization in Zambian schools, with an average score of 3.95, recognizing its potential to make math more culturally relevant and engaging for students (average score of 4.05).

Teachers were highly willing to incorporate indigenous knowledge into their math lessons, with an average score of 4.15, and shared the belief that this integration could improve students' understanding and appreciation of the subject (average score of 4.13). They also saw indigenization as a way to enhance students' academic achievement (average score of 3.98) and motivation for learning math (average score of 4.25).

**Pupils' perceptions towards indigenization of Mathematics pedagogies**

The descriptive statistics in table 2 provide insights into the pupils' perceptions on various statements related to the indigenization of mathematics education.

**Table 2: The attitudes of pupils in Zambia towards the indigenizing mathematics pedagogies and practices**

Descriptive Statistics	N	Minimum	Maximum	Mean	Std. Deviation
I am willing and interested to learn about Indigenous mathematics and its integration into the mathematics curriculum	271	1	5	3.82	1.203
I am comfortable with incorporating Indigenous knowledge and ways of knowing into the mathematics curriculum	271	1	5	3.69	1.198
I am willing to learn mathematics using indigenous methods and practices	271	1	5	3.74	1.202
Indigenizing mathematics pedagogies and practices can benefit the academic success of local students	271	1	5	3.73	1.141
The integration of Indigenous mathematics into the curriculum can help foster a more inclusive and diverse learning environment	271	1	5	3.46	1.115
The use of indigenous mathematics pedagogies and practices can enhance my understanding of mathematics	271	1	5	3.65	1.085
Valid N (listwise)	271				

There were 271 respondents that answered questions in table 2 to show their attitudes towards indigenization of mathematics. On average, the participants showed a moderate inclination (Mean = 3.56, Std. Deviation = 1.055) to adapt their learning approaches to incorporate indigenous knowledge and practices into mathematics education. The surveyed students demonstrated a reasonable grasp (Mean = 3.45, Std. Deviation = 1.143) of local cultural practices that could complement the learning of mathematics.

Respondents believed that integrating indigenous mathematical pedagogies might nurture a heightened sense of cultural identity and pride among fellow students (Mean = 3.35, Std. Deviation = 1.164). According to the students, the incorporation of indigenous pedagogies into mathematics education might enhance academic performance among peers (Mean = 3.76, Std. Deviation = 1.132).

The student respondents displayed a strong willingness and interest in acquiring knowledge about Indigenous mathematics and its integration into their curriculum (Mean = 3.82, Std. Deviation = 1.203). Scores varied from 1 to 5. Participants expressed a moderate level of comfort with the idea of incorporating Indigenous knowledge and ways of thinking into the mathematics curriculum (Mean = 3.69, Std. Deviation = 1.198).

Students demonstrated considerable willingness to learn mathematics using indigenous methods and practices (Mean = 3.74, Std. Deviation = 1.202). Students believed that integrating indigenous mathematics pedagogies and practices could positively influence the academic success of local students (Mean = 3.73, Std. Deviation = 1.141). The integration of Indigenous mathematics into the curriculum was perceived by students as a potential catalyst for cultivating a more inclusive and diverse learning environment (Mean = 3.46, Std. Deviation = 1.115). Participants believed that the utilization of indigenous mathematics pedagogies and practices could augment their personal comprehension of mathematics (Mean = 3.65, Std. Deviation = 1.085).

**Hypothesis 1: Teachers are more likely to possess positive attitudes towards indigenization of mathematics pedagogies and practices compared to their learners.**

The table below presents the results of a survey that assesses teachers' attitudes toward the indigenization of mathematics pedagogies and practices. The table includes various statements related to teachers' beliefs and willingness to incorporate indigenous knowledge and practices into their mathematics lessons.

**Table 3: Shows the teachers' attitudes toward indigenization of mathematics pedagogies and Practices**

Variables	N	Mean	Std.
I am familiar with the concept of indigenizing mathematics pedagogies and practices	55	3.44	0.811
Indigenizing mathematics pedagogies and practices in schools in Zambia is very important	55	3.95	0.803
I am willing to incorporate indigenous knowledge and practices into my mathematics lessons	55	4.15	0.803
Indigenizing mathematics pedagogies and practices can enhance students' cultural relevance and engagement in the subject	55	4.05	0.756
Integrating indigenous mathematical knowledge can improve students' understanding and appreciation of the subject	55	4.13	0.747
I believe that indigenizing mathematics pedagogies and practices can contribute to students' academic achievement	55	3.98	0.805
Valid N (listwise)	55	3.95	0.788

Comparing the mean scores of the teachers and learners we can see that the teachers generally have more positive attitudes toward indigenization. Teachers' mean scores for several items were notably higher than the learners', suggesting that they were more familiar with the concept of indigenizing mathematics, were more willing to incorporate indigenous knowledge into their lessons, and believed in the importance and potential benefits of indigenizing mathematics pedagogies.

For example, teachers scored higher (4.15) on "I am willing to incorporate indigenous knowledge and practices into my mathematics lessons" compared to learners (3.74). Teachers also scored higher (3.95) on "Indigenizing mathematics pedagogies and practices in schools in Zambia is very important" compared to learners (3.73).

The teachers generally have more positive attitudes towards indigenization of mathematics pedagogies and practices. This supports the first hypothesis that state that teachers are more likely to possess positive attitudes towards indigenization of mathematics pedagogies and practices compared to their learners.

Teachers, on average, scored higher (lower on the disagree scale) on questions related to indigenizing mathematics pedagogies and practices. For instance, they were more willing to incorporate indigenous knowledge and practices into their mathematics lessons (mean = 4.15), while learners tend to disagree (mean = 3.80). Teachers were more likely to believe that indigenizing mathematics pedagogies can contribute to students' academic achievement, promote cultural diversity, and enhance students' motivation and interest in learning mathematics. Teachers, on average, believe more strongly that indigenizing mathematics pedagogies could improve students' overall academic performance in mathematics.

The table below shows the attitudes of learners towards indigenization of mathematics pedagogies and practices

**Hypothesis 2: Learners are more likely to possess negative attitudes towards indigenization of mathematics pedagogies and practices compared to their teachers.**

**Table 4: The attitudes of learners towards indigenization of mathematics pedagogies and practices**

VARIABLES	N	Mean	Std.
I am willing and interested to learn about Indigenous mathematics and its integration into the mathematics curriculum	271	3.82	1.203
I am comfortable with incorporating Indigenous knowledge and ways of knowing into the mathematics curriculum	271	3.69	1.198
I am willing to learn mathematics using indigenous methods and practices	271	3.74	1.202
Indigenizing mathematics pedagogies and practices can benefit the academic success of local students	271	3.73	1.141
The integration of Indigenous mathematics into the curriculum can help foster a more inclusive and diverse learning environment	271	3.46	1.115
The use of indigenous mathematics pedagogies and practices can enhance my understanding of mathematics	271	3.65	1.085
I think that indigenizing mathematics pedagogies and practices can lead to a better understanding of mathematics among students	271	3.83	1.099
Incorporating indigenous knowledge and cultural practices in mathematics teaching can make the subject more engaging and relevant to pupils	271	3.68	1.133
I believe that integrating indigenous stories, folklore, or examples in mathematics instruction can enhance my understanding of mathematical concepts	271	3.46	1.304
My perception is that indigenous pedagogies (teaching methods) can be effective in helping pupils learn mathematics better	271	3.66	1.137
I am willing to engage in discussions about the potential ways of indigenizing mathematics pedagogies in my classroom.	271	3.83	1.145
I have a very high level of interest in exploring alternative mathematical systems that are based on indigenous knowledge and practices.	271	3.70	1.117
I feel confident that learning mathematics through indigenized pedagogies and practices can improve the performance in mathematics	271	3.80	1.179
Valid N (listwise)	271	3.70	1.158

Upon analyzing the data, it was found that both learners and teachers generally have positive attitudes towards indigenization. However, when comparing the mean scores, teachers tend to have slightly more positive attitudes than learners. This suggests that teachers are more enthusiastic and supportive of integrating indigenous knowledge into mathematics education.

The results showed that learners generally have a positive attitude towards indigenization as well. However, when comparing the mean scores, teachers tend to have slightly more positive attitudes. While both groups generally support the idea of indigenization, teachers seem to be more enthusiastic and supportive of integrating indigenous knowledge into mathematics education.

The data suggests that learners, on the other hand had less positive attitudes toward the indigenization of mathematics pedagogies and practices. Learners, on average, scored lower (closer to "disagree") on questions related to indigenizing mathematics pedagogies and practices. For example, they were less willing to incorporate indigenous knowledge and practices into their mathematics lessons (mean = 3.82), while teachers were more open to it.

The learners were less likely to believe that indigenizing mathematics pedagogies could enhance students' cultural relevance and engagement in the subject, improve their understanding and appreciation of mathematics, or foster a sense of pride and cultural identity. Learners also tended to disagree more strongly that teachers currently incorporate indigenous knowledge and practices in their teaching methods and that teachers believe in the potential benefits of indigenizing mathematics pedagogies.

The data from both teachers and learners suggest that both groups generally have positive attitudes towards the indigenization of mathematics pedagogies and practices. However, teachers, on average, exhibited slightly more positive attitudes compared to learners, supporting both Hypothesis 1 and Hypothesis 2 to some extent.

Qualitative findings on the attitudes of mathematics teachers towards indigenizing pedagogies and practices

The following presents the qualitative results that emerged from the study. The qualitative results presented showed a mixed nature of attitudes in both teachers and learners towards the indigenization of mathematics pedagogies and practices.

### Teachers' Perspectives on Indigenizing Pedagogies in Mathematics Education

The study revealed that teachers were in support of using indigenized pedagogies and practices in the teaching of mathematics in schools. The perception of teachers was generally positive. It was noted that most of the participants involved in the study demonstrated a positive attitude towards the potential ways of indigenizing mathematics pedagogies and practices in teaching mathematics. One of the participants stated that he believed that indigenizing mathematics pedagogies was a crucial step towards making the subject more relevant and relatable to our diverse student population in the schools in Zambia. One of the participants contended that:

**Participant 4:** *"incorporating indigenous knowledge and perspectives can foster a deeper understanding and appreciation for the subject among our students." "I've always been interested in exploring different teaching approaches. Indigenizing mathematics offers a chance to make the subject more engaging and meaningful to students who may struggle with its abstract nature.*

The participants in the study were willing and open to incorporate and explore new approaches in teaching mathematics. One of the teachers had the following to support:

**Participant 9** stated that, *Indigenizing mathematics teaching approaches is a fantastic idea! It's a way to break away from traditional Western-centric methods and foster cultural pride among our students. I'm excited to explore how we can integrate local knowledge and examples into our lessons.*

However, some of the participants were worried that indigenizing the teaching pedagogies could dilute the core mathematical concepts. As a result, the participants were for the idea of creating a balanced approach between preserving the integrity of the subject while acknowledging and appreciating the indigenous contributions. One of the key informants narrated that:

**Participant 4:** *I'm open to exploring new approaches in teaching mathematics, but I worry that incorporating indigenous elements might dilute the core mathematical concepts. We need to strike a balance between preserving the integrity of the subject while acknowledging and appreciating indigenous contributions.*

### Factors that influenced the attitudes of teachers towards indigenizing pedagogies and practices in mathematics

The study revealed several themes that influenced the attitudes of teachers towards indigenizing the pedagogies and practices in the teaching of mathematics in schools. The second theme that emerged was that of teacher's

beliefs and attitudes towards indigenization of mathematics teaching approaches. The participants were in support of indigenization of mathematics teaching approaches. One of the participants investigated stated that indigenization of pedagogies and practices could be the best ways to make mathematics more relatable and meaningful to Indigenous students.

**Participant 6:** *At first, I was skeptical about incorporating Indigenous perspectives into mathematics teaching. But as I learned more about their rich mathematical traditions and cultural knowledge, I realized how important it is to include these in the curriculum. It can make mathematics more relatable and meaningful to Indigenous students.*

Teachers argued that the use of indigenous examples has the potential to increase student engagement and increase their curiosity in the learning of mathematics. The teachers involved in the study reviewed that the use of local examples could be effective in the teaching of mathematics.

**Participant 3:** *“I was hesitant to change my teaching approach initially, fearing it might deviate from the prescribed curriculum. However, I've noticed that using Indigenous examples and contexts has increased student engagement and sparked curiosity about different cultures.*

Other factors that emerged influencing the teacher’s attitudes towards indigenizing pedagogies and practices in the teaching of mathematics in schools were summarized on the figure below:



**Figure 1: Factors that emerged influencing the teacher’s attitudes towards indigenizing pedagogies and practices in the teaching of mathematics**

**Challenges of indigenizing Mathematics pedagogies and practices**

The study further explored the challenges and obstacles that mathematics teachers might face when trying to incorporate indigenous elements into their teaching approaches. One of the participants highlighted a crucial challenge faced by educators in the research study.

**Participant 1:** *One of the biggest challenges we faced as mathematics teachers was finding appropriate resources and materials that were culturally relevant to our indigenous students. The standard curriculum and textbooks often lacked representation of our students' cultures, which made it difficult to engage them in the learning process"*

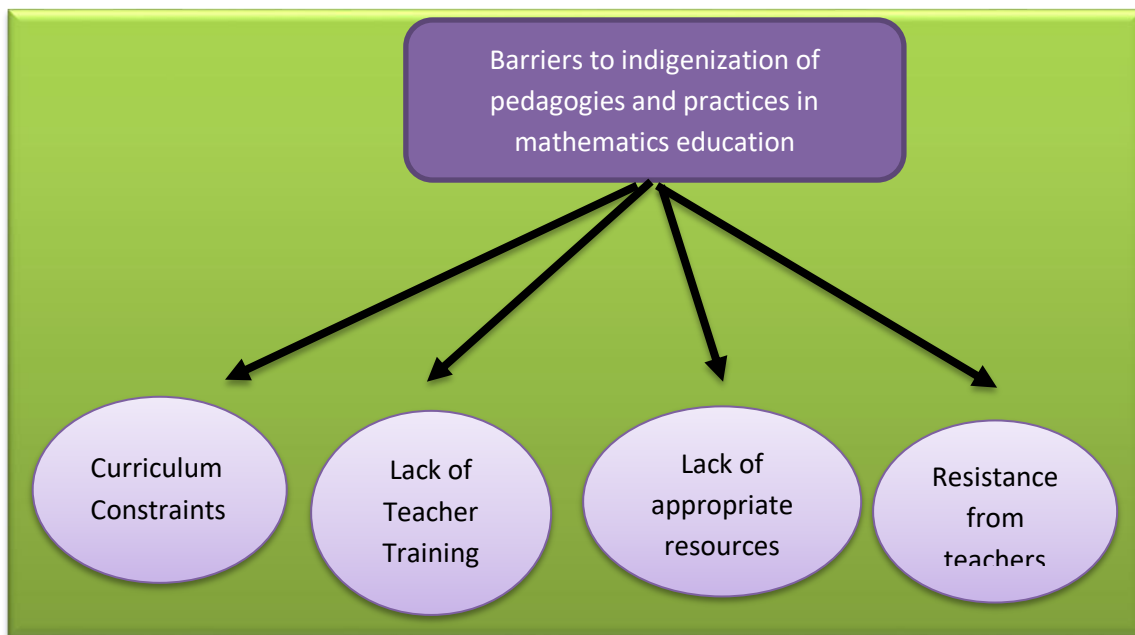
The primary concern of one of the participants revolved around the lack of culturally relevant teaching materials, which hindered effective engagement and connection with their students.

**Participant 4:** *"One of the main challenges I faced as a mathematics teacher while trying to indigenize pedagogies was the lack of culturally relevant teaching materials. Most of the existing textbooks and resources were based on Western mathematical concepts and examples, which made it difficult to connect with my indigenous students. I had to spend a lot of time searching for or creating materials that incorporated traditional knowledge and perspectives"*

One of the participants offered valuable information on the challenges faced while incorporating indigenous practices into the math curriculum and the efforts undertaken to overcome resistance from students and parents.

**Participant 11:** *"Indigenizing pedagogies in mathematics was met with resistance from some students and even parents. They were accustomed to the traditional Western-style teaching methods and were skeptical about incorporating indigenous practices. It required extensive communication and collaboration with the community to gain their trust and show the value of incorporating their cultural heritage into the math curriculum."*

The figure below summarizes the challenges towards indigenizing the pedagogies and practices in teaching mathematics in schools



**Figure 2: Challenges towards indigenizing the pedagogies and practices in teaching mathematics in schools**

Teacher preparedness towards indigenizing the pedagogies and practices in the teaching of mathematics.

The other theme that was generated was about teacher preparedness towards indigenizing the pedagogies and practices in the teaching of mathematics. This theme examined the readiness of mathematics teachers to implement indigenized pedagogies. It involves assessing their level of knowledge, skills, and confidence in designing and delivering lessons that integrate indigenous perspectives.

The study reviewed whether additional training or support is required to enhance teacher preparedness in this regard. Participant 6 expresses uncertainty and lack of confidence in their ability to effectively incorporate indigenous elements into their math lessons. This lack of confidence stems from a lack of training and resources in this area.

**Participant 6:** *“I’m not really sure how to incorporate indigenous elements into my math lessons. I haven’t received much training or resources on this, and I worry that I might misrepresent or misunderstand the cultural aspects.”*

**Benefits of indigenizing the pedagogies and practices in the teaching of mathematics**

One of the major themes that emerged was that of student engagement and learning outcomes towards indigenizing the pedagogies and practices in the teaching of mathematics.

**Participant 3:** *“I foresee a significant improvement in student motivation once we start indigenizing the math curriculum. Students who used to be disinterested will actively participate in class discussions. They will feel a sense of pride in their cultural heritage and its contributions to mathematics, which translates into better learning outcomes.”*

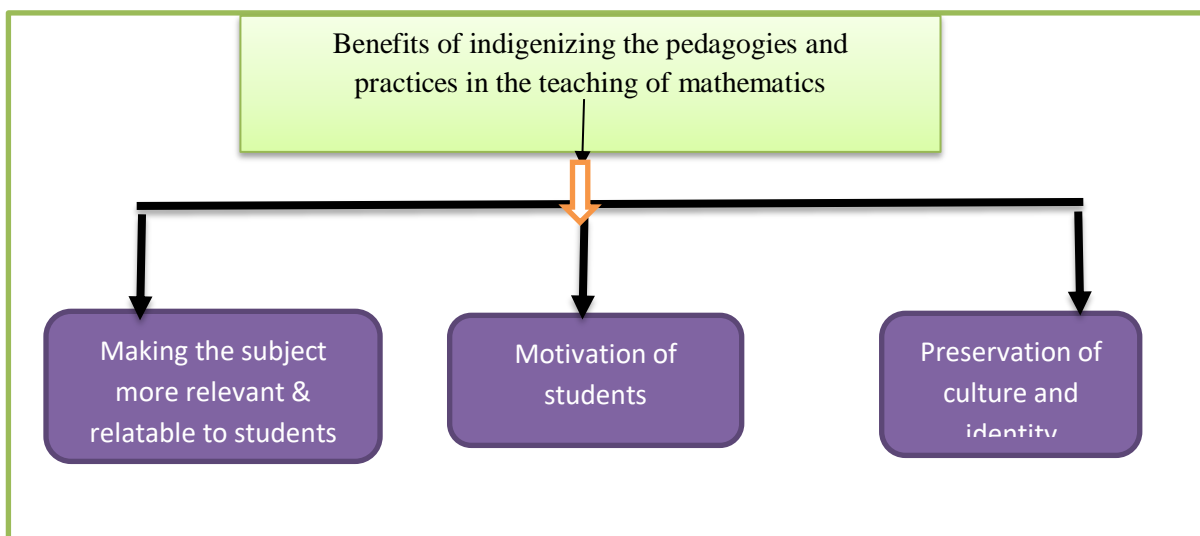
We investigated the impact of indigenization on student engagement and learning outcomes in mathematics. The study assessed whether incorporating indigenous knowledge and practices positively influences students' motivation, understanding, and performance in the subject. The teachers that were involved in the study indicated there was a high possibility of having the learning outcomes improve if we were to consider indigenizing the teaching pedagogies in mathematics education.

**Participant 17:** *“Indigenization can be a game-changer in mathematics education. Before, many students struggled to connect with the subject, and it felt distant from their own cultural experiences. But with indigenization, incorporating culturally relevant examples and teachings into the curriculum. Students could be more engaged because they see the relevance of math in their own lives and communities.”*

The study revealed that there is need for professional development and training for mathematics teachers to effectively incorporate indigenous perspectives into their teaching. The study identified the gaps in the knowledge of teachers, suggesting relevant workshops or courses, and outlining strategies for continuous improvement. Results from Participant 10's input suggest that there is a positive perspective on the idea of incorporating Indigenous ways of knowing and examples in math education.

**Participant 10:** *Yes, exactly! I feel that understanding Indigenous ways of knowing and incorporating Indigenous examples in math problems would not only engage Indigenous students but also provide a more holistic and meaningful learning experience for all students.*

The figure below summarized the benefits of indigenizing the pedagogies and practices in the teaching of mathematics:



**Figure 3: The benefits of indigenizing the pedagogies and practices in the teaching of mathematicsz**



## DISCUSSION OF RESULTS

Battiste (2013) argued that indigenizing teaching methods refers to the incorporation of indigenous knowledge, perspectives, and pedagogies into educational practices. This approach recognizes the importance of indigenous cultures, histories, and ways of knowing, and aims to create a more inclusive and culturally responsive learning environment. In recent years, there has been growing recognition of the advantages of indigenizing teaching methods. This article would show several key advantages of indigenizing teaching methods, drawing on scholarly literature and research.

The study revealed that teachers and learners strongly support the use of indigenized teaching methods for mathematics education. This finding offers a promising opportunity to enhance math education in the province. However, it also underscores the need for increased awareness and education in this area to fully leverage the potential of indigenized pedagogies. There were several reasons given by the teachers as to why they supported the use of indigenized teaching methods for mathematics education.

Firstly, it makes education more pertinent to the local context, bridging the gap between abstract mathematics concepts and students' daily lives. By incorporating traditional knowledge, cultural practices, and local examples into the math curriculum, it not only enhances engagement but also demonstrates the practical applications of math within their communities. Furthermore, indigenized teaching methods help students connect with their cultural heritage, bolstering their sense of identity and self-esteem.

The other advantage revealed as to why teachers and learners supported the use of indigenized teaching methods for mathematics education was that Indigenizing teaching methods provide students with an opportunity to learn about their own cultural heritage and identity. Kovach (2010) argued that by incorporating indigenous knowledge and perspectives into the curriculum, students are able to see themselves reflected in the material being taught. This can lead to increased engagement, motivation, and a sense of pride in one's cultural heritage. Furthermore, indigenizing teaching methods empower indigenous students by validating their knowledge and ways of knowing, which can contribute to improved self-esteem and academic success.

The participants from the qualitative data perspective supported the use of indigenous teaching methods because this approach promotes a deeper understanding of the subject matter and encourages critical thinking, problem-solving, and creativity.

Smith (2012) argued that Indigenous pedagogies often emphasize a holistic approach to learning, which recognizes the interconnectedness of all aspects of life. Indigenizing teaching methods incorporate experiential learning activities, such as storytelling, land-based learning, and community engagement, which allow students to engage with the material in a meaningful and hands-on way.

The other advantage revealed by the participants as to why they supported the use of indigenous teaching methods was that such methods provide an opportunity to address the historical and ongoing impacts of colonization on indigenous communities. Smith (2012) argued that by incorporating indigenous perspectives and histories, educators can challenge dominant narratives and promote a more accurate and inclusive understanding of history. This can help to counteract the erasure and marginalization of indigenous knowledge and contribute to the process of decolonization.

The participants supported the use of indigenous teaching methods because Indigenized teaching methods promote intercultural understanding and respect by fostering dialogue and collaboration between indigenous and non-indigenous students. By learning about indigenous cultures, histories, and ways of knowing, non-indigenous students can develop a greater appreciation for diversity and challenge stereotypes and prejudices. This can contribute to the development of more inclusive and equitable societies.

Moreover, these methods can strengthen the ties between schools and the local community. Parents and community members are more likely to get involved in their children's education when they see that the curriculum respects and values their culture, potentially leading to greater support for education initiatives and improved learning outcomes.

The study also points to the need for teacher training programs to enhance familiarity with indigenizing mathematics pedagogies. Workshops and training sessions can help educators better understand and implement these methods, including integrating local traditions, history, and ways of knowing into mathematics lessons. Additionally, there is a call to revise the mathematics curriculum to include indigenized elements. Collaboration between curriculum developers, education authorities, local communities, and experts is crucial to creating a curriculum that aligns with the unique cultural context of Kalomo District. This may involve developing teaching materials, resources, and lesson plans that adhere to indigenized pedagogies.

The results reveal that both teachers and learners are willing to embrace indigenous approaches when they perceive students as performing well in mathematics, aligning with existing educational literature. This analysis provides insights into the factors influencing teachers' attitudes toward indigenizing mathematics education. The regression analysis revealed a statistically significant positive relationship between teachers' perceptions of students' mathematics performance and their willingness to embrace indigenous approaches. This finding suggests that teachers are more likely to incorporate indigenous knowledge and approaches into their mathematics instruction when they perceive their students as performing well in mathematics.

The results of this study provide insights into the factors influencing teachers' attitudes toward indigenizing mathematics education. Attitudes of mathematics teachers towards the indigenization of pedagogies and practices in mathematics education can vary based on factors such as cultural background, teaching experience, and knowledge of indigenous pedagogies. Several studies have explored these attitudes and shed light on the challenges and potential solutions for incorporating indigenous knowledge into mathematics education.

The findings align with existing educational literature, which emphasizes the importance of recognizing and valuing diverse mathematical practices and ways of knowing (Bishop, 2002; Skovsmose, 2005). By understanding the relationship between teachers' perceptions of students' mathematics performance and their willingness to embrace indigenous approaches, educators and policymakers can develop strategies to promote the integration of indigenous knowledge into mathematics education. One study conducted in China examined the knowledge and beliefs of elementary mathematics teachers regarding fraction division (Li & Huang, 2008). The results revealed a gap between teachers' limited knowledge about the curriculum they teach and their solid mathematics knowledge for teaching. This suggests that teachers may need support and training to enhance their understanding of indigenous pedagogies and incorporate them effectively into their teaching practices.

Another study conducted in South Africa focused on the attitudes of pre-service mathematics teachers towards modeling in mathematics education (Jacobs and Durandt, 2016). The findings indicated that teachers who were not comfortable with the subject area tended to have less positive attitudes towards mathematics and preferred teaching in a procedural manner. This suggests that teachers' attitudes towards mathematics can influence their willingness to embrace new pedagogical approaches, including those that incorporate indigenous knowledge.

A study in Australia explored the challenges faced by teachers in developing a differentiated approach to indigenous pedagogies (Funk and Woodroffe, 2023). The research highlighted the complexity of understanding and implementing indigenous pedagogies due to variations in cultural understandings and available information. The study emphasized the importance of engaging in respectful, relational, and reconciliatory practices to effectively incorporate indigenous pedagogies into mathematics education.

Gender also plays a role in teachers' attitudes towards mathematics education. A study on curriculum analysis from an indigenous knowledge and gender perspective identified several factors contributing to the gender gap in mathematics achievement, including teachers' gendered attitudes and beliefs (Subedi, 2021). This suggests that addressing teachers' attitudes towards gender and mathematics can contribute to creating a more inclusive and equitable learning environment.

Skovsmose (2005) emphasizes the significance of incorporating indigenous perspectives into mathematics education by highlighting the potential benefits for students from indigenous backgrounds. He argues that this approach can help students connect with the subject matter on a deeper level, as it allows them to see mathematics as relevant to their own cultural experiences and ways of knowing. By incorporating indigenous perspectives, mathematics education becomes more inclusive, as it recognizes and values diverse ways of understanding and engaging with

mathematical concepts. Furthermore, Skovsmose (2005) suggests that incorporating indigenous perspectives into mathematics education can contribute to the broader goals of decolonizing the curriculum and promoting social justice in education. By challenging the dominant Eurocentric narratives in mathematics education, this approach seeks to disrupt power imbalances and create space for marginalized voices and knowledge systems. It acknowledges the historical and ongoing marginalization of indigenous knowledge and seeks to rectify this by centering indigenous perspectives in the curriculum.

However, there were concerns about diluting core mathematical concepts while integrating indigenous knowledge. Striking a balance between preserving mathematical integrity and appreciating indigenous contributions is essential. Curriculum development requires collaboration between mathematicians, educators, and indigenous knowledge holders, as well as specialized training for teachers in cultural competence.

Several scholars have contributed to the understanding of indigenous knowledge and its relationship with mathematics education. D'Ambrosio (2001) introduces the concept of ethno-mathematics, which recognizes the mathematical knowledge embedded in different cultures. He argues that ethno-mathematics can serve as a bridge between traditional knowledge systems and modern mathematics. Greer (2005) discusses the challenges and opportunities of integrating indigenous knowledge into mathematics education, emphasizing the need for culturally responsive pedagogy. Setati (2005) focuses on the South African context and highlights the importance of recognizing and valuing indigenous mathematical knowledge. She argues that incorporating indigenous knowledge can enhance students' understanding and engagement with mathematics.

To strike a balance between preserving mathematical integrity and appreciating indigenous contributions, collaboration between mathematicians, educators, and indigenous knowledge holders is crucial. Mathematicians can provide expertise in ensuring that core mathematical concepts are not diluted while incorporating indigenous knowledge. Educators can contribute their pedagogical knowledge to develop culturally responsive teaching strategies. Indigenous knowledge holders can provide insights into traditional mathematical practices and their relevance to contemporary contexts. Furthermore, specialized training for teachers in cultural competence is essential. Teachers need to develop an understanding and appreciation of diverse cultural perspectives to effectively integrate indigenous knowledge into mathematics education. This training should include learning about different cultural practices, beliefs, and values related to mathematics, as well as strategies for creating inclusive and culturally responsive learning environments.

### RECOMMENDATIONS

Based on these results, the study proposes the following recommendations:

**Teacher Training and Professional Development:** There is a clear need for teacher training programs to familiarize educators with indigenizing teaching methods in mathematics education. Workshops, training sessions, and ongoing professional development can help teachers better understand and implement these methods effectively.

**Curriculum Revision:** Collaboration between curriculum developers, education authorities, local communities, and experts is crucial to revising the mathematics curriculum to include indigenized elements. This process should involve the development of teaching materials, resources, and lesson plans that align with the unique cultural context.

**Address Teachers' Attitudes:** Recognize that teachers' attitudes play a significant role in the success of indigenizing mathematics education. Understanding and addressing factors such as cultural background, teaching experience, and knowledge of indigenous pedagogies can help create a more supportive environment for these approaches.

**Interdisciplinary Collaboration:** Collaboration between mathematicians, educators, and indigenous knowledge holders is essential to strike a balance between preserving mathematical integrity and incorporating indigenous contributions. Mathematicians can ensure core mathematical concepts remain intact, educators can develop culturally responsive teaching strategies, and indigenous knowledge holders can provide insights into traditional mathematical practices.

**Promote Inclusivity and Equity:** Recognize that indigenizing teaching methods not only benefit indigenous students but can also foster intercultural understanding and respect among all students. Encourage dialogue and collaboration between indigenous and non-indigenous students to challenge stereotypes and prejudices, contributing to more inclusive and equitable societies.

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