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Indigenous People Mathematics Teachers' Beliefs and Teaching Practices: An Explanatory Sequential Analysis

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Abstract. Indigenous communities have a rich cultural heritage encompassing diverse ways of knowing, learning, and understanding the world around them. This mixed methods study utilized the explanatory sequential design to determine the level and relationship of the IP mathematics teachers' beliefs and teaching practices and gain a deeper insight into these beliefs and attitudes. There are 115 respondents for the quantitative phase, while 10 participants in the qualitative phase. Data were collected through survey and key informant interviews and were analyzed through mean, standard deviation, Pearson product moment correlation, and thematic analysis. Results showed that the IP mathematics teachers possess high levels for both beliefs and teaching practices, and a significant moderate positive relationship exists between the two variables. Qualitative data analysis revealed that teachers' beliefs include the ideal qualities of an effective mathematics teacher, respect for students' culture and background, and a constructivist approach to teaching. Teaching practices include discussing student performance and intervention during meetings, implementing culturally relevant approaches, technology, varied activities, and peer mentoring and coaching. Further, it is concluded that teachers' belief, which influences teaching practices, is shaped by different environmental factors. It is recommended that IP mathematics teachers continue to participate in personal and professional development activities and strengthen collaboration and reflection.

Keywords: Beliefs; Culturally responsive teaching; Indigenous People; Mathematics education; Teaching practices.

1.0 Introduction

Indigenous communities have a rich cultural heritage encompassing diverse ways of knowing, learning, and understanding the world around them. In recent years, there has been growing interest in exploring the relevant ideas involving Indigenous people in various educational contexts, including the field of mathematics education (Edilo et al., 2022; Nur et al., 2021; Acharya et al., 2021; Rigney et al., 2020). Within the realm of education, the inclusion and recognition of Indigenous knowledge systems and practices are crucial for promoting culturally responsive pedagogy and fostering educational equity.

Realizing the importance of the inclusion of Indigenous education, countries worldwide have established measures to meet this demand. Programs in Indigenous education have been put in place in many developed countries, such as the First Nations, Inuit, and Métis education programs in Canada (Greenwood et al., 2020), Kaupapa Māori in New Zealand (Pihama, 2019), Aboriginal and Torres Strait Islander Education in Australia (Price & Rogers, 2019), Indian Education Act and the Johnson-O'Malley Act in the United States of America (Marcus & Zens, 2023), and Sámi Education in Norway (Keskitalo, 2019). In Asia, Indigenous education programs

include Tribal Education in India (Velusamy, 2021), Orang Asli Education Programme in Malaysia (Rosnon, 2016), the Education Act for Indigenous Peoples in Taiwan (Ministry of Education, 2020), and others. By including Indigenous education, societies can move toward a more inclusive, diverse, and fair educational system that respects and recognizes Indigenous peoples' contributions, perspectives, and rights.

In the Philippines, programs were implemented to enhance the educational quality received by the Indigenous communities. According to DepEd (2021), in the first ten years of the Indigenous Peoples Education (IPEd) Program, the Philippine Department of Education (DepEd) served 2.529 million IP students in 42,176 public schools across the nation. The policy takes a rights-based stance and specifies how to create a curriculum that is based on the social and cultural milieu of IP learners.. However, even with the implementation of such programs, Fiagoy (2000) determined the causes of the failure in educating indigenous people, which include lack of contextualization of the lessons, lack of integration of indigenous cultural values in the classroom, lack of understanding of the way indigenous people learn, and lack of understanding of indigenous people's needs, lack of vision for their empowerment, among others. This assumes, in large part, that teachers' belief affects their teaching practices, which in turn affect IP students' learning and performance.

Similarly, Parajes (1992) emphasized the relevance of the individual theories that teachers develop on the nature of mathematics and the teaching and learning of mathematics in their decision-making and choice of teaching strategies, reflecting the teachers' beliefs. Likewise, Kupari (2003) stated that teachers' beliefs are critical in the implementation of their teaching and learning process in the classroom. The teachers' abilities to create meaningful classroom activities (Beswick, 2011) can be traced back to the three dimensions of mathematics beliefs: beliefs in the nature of mathematics, beliefs in teaching mathematics, and beliefs in learning mathematics (Zakaria & Musiran, 2010).

The Paaralang Mangyan na Angkop sa Kulturang Aalagaan (Pamana Ka), an indigenous school built in 1999 by and for the Mangyan community in San Jose, Occidental Mindoro Philippines, claimed their education is done right. At Pamana Ka, Math comes to life in the Mangyan traditions. For instance, a lesson on fractions begins with a discussion on the honey-harvesting practices in each student's community and concludes by reflecting on the values of sharing and fairness. Pamana Ka teachers find ways to teach mathematics concepts that start with things familiar to the Mangyan student (Llaneta, 2021). Indeed, this demonstrates that establishing good mathematical beliefs would lead teachers to positive and effective teaching practices (Zakaria & Maat, 2012).

Meanwhile, Davao Occidental is one of the few provinces in the Philippines where four or more distinct ethnic tribes built their own cultural communities in specific areas of the province. The Tagacaolo tribe accounts for the more significant percentage of the indigenous population, the Balkans, the Manobo, and the Muslim communities. This setting comprises different teachers and learners with culturally different beliefs and practices. This scenario calls for teachers' preparations to meet the needs of diverse learners. The implication of teachers' beliefs on their teaching practices can be classified according to what they do in class. The teaching practices should reflect the kind of mathematics beliefs the teachers hold (Zakaria & Maat, 2012).

With the present move towards culturally responsive pedagogy, there exists a great need to examine the teachers' beliefs and teaching, especially in the locality of Davao Occidental. However, no study has yet investigated and probed the level of beliefs and teaching practices and their relationship among the IP mathematics teachers within Davao Occidental. Considering these, this study sought to investigate the IP mathematics teachers' level of beliefs and teaching practices and their relationship.

2.0 Methodology

2.1 Research Design

This mixed methods study utilized the explanatory sequential design. According to Creswell and Creswell (2018), explanatory sequential design is a two-phased design wherein data collection and analysis starts with the quantitative phase and is followed by the collection and analysis of qualitative data. In this design, qualitative data is used to explain the quantitative data. Figure 1 shows the flow chart using the explanatory sequential design.

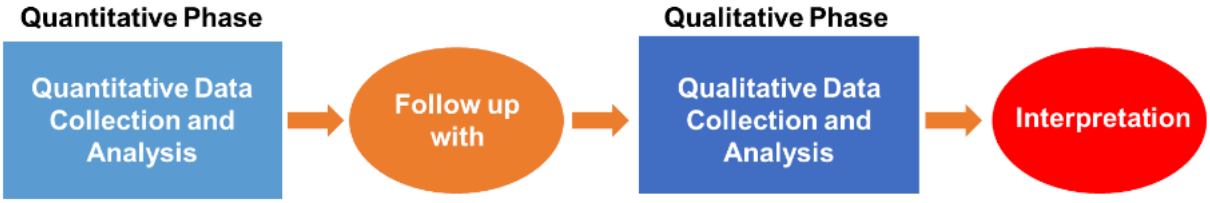

Figure 1. explanatory sequential design flowchart

The explanatory sequential design is appropriate in this study since the study aimed to gain a deeper understanding of the IP mathematics teachers' beliefs and practices in teaching and the relation between the two constructs. Further, the study is interested in explaining the items in the quantitative phase which got the highest and lowest scores and the observed relationship between beliefs and teaching practices. This allowed the researcher to see the deeper meaning, insights, and explanation for the underlying structures behind the participants' responses. Moreover, the design enhances the study's validity by combining the strengths and minimizing the weaknesses of the quantitative and qualitative methods. A robust statistical analysis is provided in the quantitative phase, ensuring the reliability of the results, while the qualitative phase enables a more profound knowledge of the lived experiences and views of IP mathematics teachers.

2.2 Research Locale and Participants

The study respondents were selected using a clustered sampling for the quantitative phase while purposive sampling is used in the qualitative phase. Cluster sampling is a common probability sampling technique used for studying large and geographically disperesed population (Thomas, 2023). This sampling technique is appropriate for the study given that the population of the IP teachers is greatly distributed among the rural areas of Davao Occidental. In the context of the study, the clusters were the IP mathematics teachers per school and the schools were selected randomly. For the qualitative phase, purposive sampling is a non-probability sampling in which the researcher selects the study respondents rich in experience and knowledge of the phenomenon under study. This sampling technique is also called judgmental sampling, as the researcher relies on his/her judgment in selecting the study participants to attain the study's objectives (Nikolopoulou, 2023). The participants of this study were the IP mathematic teachers from randomly selected elementary and secondary public schools within the Municipality of Malita, Davao Occidental. There are 115 respondents for the quantitative phase of the study and 10 participants for the qualitative phase.

2.3 Research Instrument

The study utilized the explanatory sequential mixed methods design comprising quantitative and qualitative phases. Therefore, the study used two sets of instruments. The researcher adopted the OECD (2018) TALIS Teacher Questionnaire on Teaching Beliefs and Practices for the quantitative phase. The survey questionnaire was adapted to measure the level of IP mathematics teachers' teaching beliefs and practices. The survey questionnaire was divided into two sections – one for each scale (beliefs and practices). The survey questionnaire for teaching beliefs is composed of 12 questions, and the survey questionnaire to assess the teaching practices scale is also composed of 12 questions. To establish the validity of the questionnaire, the instrument was subjected to an expert validation for content validity. Further, to assess the instrument's reliability, the questionnaire was pilot tested on 45 IP mathematics teachers. The reliability test result conducted on 45 IP mathematics teachers was tabulated in Table 1.

Table 1. Reliability test result

Scale	Cronbach's Alpha	Number of Items	Interpretation
Beliefs	0.771	12	Acceptable
Teaching Practices	0.885	12	Good
Overall	0.886	24	Good

Table 1 shows that the questionnaire's internal consistency on beliefs scale is $\alpha = .771$ which was interpreted as "acceptable." In addition, the questionnaire's internal consistency on teaching practices scale is $\alpha = .885$ which was interpreted as "good." Overall, the internal consistency of the OECD (2018) TALIS Teacher Questionnaire on

Teaching Beliefs and Practices is α = 886, which has a descriptive interpretation as "good." This implies that the questionnaire is good to use in assessing the level of IP mathematics teachers' beliefs and practices in teaching.

2.4 Data Gathering Procedure

The researchers strictly implemented the following procedures throughout the study: First, letters were written addressed to the Dean of the Advanced Studies of the College of Education. Likewise, a letter of endorsement was sought for the Schools Division Superintendent of the DepEd, Davao Occidental Division, the research locale, to conduct the study. The researchers asked the school principal to conduct pilot testing as a preliminary procedure before conducting the research. As mentioned earlier, the test questionnaires, both the researcher-made and the adopted questionnaires, were used to conduct pilot testing. The researcher administered the pilot test at a public school in another municipality in Davao Occidental. Then, the result of the pilot test underwent a reliability test administered by a data analyst. After this, the researcher sent another permission letter to the school principal for the study's conduct. Once approval has been secured, the research instrument was uploaded to Google Forms to quickly gather the data and respondents' preferences. Letter invitations were written and addressed to the in-service teachers. Since they are already of age, their consent is required for their participation in the study. Once they signed the informed consent form, the researcher forwarded the Google form link or hard copy for the accomplishment of the tool. It will take the in-service teachers 10-15 minutes to accomplish the survey tool. Once the data were complete, answered questionnaires were then gathered, responses were encoded, and subjected to the appropriate statistical computations.

2.5 Ethical Considerations

Ethical considerations are paramount in research to ensure the well-being and rights of participants while maintaining integrity throughout the study. This includes aspects such as voluntary participation, where participants were required to sign consent forms, and were informed of their right to withdraw at any time. Privacy and confidentiality were rigorously upheld, with the researcher guaranteeing anonymity and employing stringent measures, such as data encryption and restricted access, to safeguard sensitive information. Transparency was also prioritized, with participants fully briefed on the study's objectives, risks, and procedures to mitigate any potential misrepresentation or misunderstanding. These ethical principles collectively guided the research process, ensuring ethical conduct and protection of participants' rights.

3.0 Results and Discussion

3.1 Level of Indigenous People (IP) Mathematics Teachers' Beliefs

Beliefs in teaching refer to the personal convictions, values, and assumptions held by educators about the nature of teaching, learning, and the role of education in society. These beliefs shape teachers' instructional decisions, interactions with students, and overall approach to teaching. They influence the selection of teaching strategies, classroom management practices, assessment methods, and the creation of learning environments (Pajares, 1992). Table 2 presents the Indigenous people (IP) Mathematics teachers' level of teaching beliefs.

It can be noted in Table 2 that item 1, "*I believe that, in teaching mathematics, effective or good teachers demonstrate the correct way to solve a problem*," received the highest mean (M=4.71, SD=.509) and with a description equivalent of "*very high*." This was followed by item 7, "*I believe that, in teaching mathematics, instruction should be built around problems with clear, correct answers, and around ideas that most students can grasp quickly,*" which also has a description equivalent of "*very high*" and obtained the second highest mean (M=4.59, SD=.591). The result signifies that IP mathematics teachers believe that effective teachers lead their students to the proper problem-solving method by demonstrating it. This notion is supported by Bandura's theory of vicarious learning which emphasize that learning can occur through observing the behavior of others (Mayes, 2015), in this case, a more knowledgeable adult.

Additionally, IP mathematics teachers believe that mathematical concepts should be presented in a way familiar to IP learners. The result implies that IP mathematics teachers believe that for the students to make sense of the topics, it must be presented to them in a way that is responsive to their culture as it is more familiar and meaningful to IP learners. This result agrees with Edilo et al. (2022) that contextualization and localization are ways teachers can adopt to make their classrooms culturally responsive.

Table 2. Level of Indigenous People (IP) mathematics teachers' beliefs

Item No.	Indicator	Mean	SD	Description
	I believe that, in teaching mathematics…			
1.	an effective or good teachers demonstrate the correct way to solve a problem.	4.71	0.509	Very High
7.	instruction should be built around problems with clear, correct answers, and around ideas that most students can grasp quickly.	4.59	0.591	Very High
9.	students should be allowed to think of solution to practical problems themselves before the teacher shows them how they are solved.	4.43	0.727	Very High
4.	my role as a teacher is to facilitate students' own inquiry.	4.39	0.71	Very High
8.	how much students learn depends on how much background knowledge they have, that is why teaching facts is so necessary.	4.31	0.667	Very High
6.	students learn best by finding solutions to problems on their own.	4.29	0.77	Very High
12.	thinking and reasoning processes are more important than specific curriculum content.	4.23	0.689	Very High
10.	when referring to a "good performance", a performance that lies above the previous achievement level of the student.	4.19	0.771	High
3.	it is better when the teacher and not the student-decides what activities are to be done.	4.15	0.704	High
2.	when referring to a "poor performance", a performance that lies below the previous achievement level of the student.	3.93	0.71	High
11.	a quiet classroom is generally needed for effective learning.	3.86	0.782	High
5.	teachers know a lot more than students; they shouldn't let students develop answers that may be incorrect when they can just explain the answers directly.	3.77	1.001	High
	Overall	**4.24**	**0.774**	**Very High**

1.00–1.80 = Very Low 3.41–4.20 = High
1.81–2.60 = Low 4.21–5.00 = Very High
2.61–3.40 = Moderate

On the other hand, table 2 shows that item 5, "*I believe that, in teaching mathematics, teachers know a lot more than students; they shouldn't let students develop answers that may be incorrect when they can just explain the answers directly*", and item 11, "*I believe that, in teaching mathematics, a quiet classroom is generally needed for effective learning*" received the lowest means among the items in the scale, with M=3.77 (SD=1.001) and M=3.86 (SD=0.782) respectively. Although both items have a descriptive equivalent of "*high,*" it is still notable since more respondents have rated these items low. The result suggests that IP mathematics teachers favor the constructivist approach to teaching and learning in which students play a more active role in learning. The teacher's role is to facilitate learning rather than the traditional approach in which teachers are seen as the fountain of knowledge. The result of this study follows Callaman and Itaas (2020) that teachers can use various instructional techniques to help students get interested in mathematics and build positive learning attitudes. Moreover, according to Tokac et al. (2019), using learner-centered activities, such as game-based mathematics activities, contributed to higher learning gains than traditional instructional methods.

Furthermore, IP mathematics teachers somehow believe that a quiet classroom equates to effective learning. By introducing varied techniques, the teacher designs and employs engaging activities that require the learners' active participation and, in turn, create academic noise. This result suggests that IP teachers value active learning more than passive learning. The result of this study is in harmony with Theobald et al. (2020), which found that active learning reduced achievement gaps in exam scores and passing rates, thus benefiting students.

Table 2 shows that the Indigenous people (IP) mathematics teachers have a very high level of teaching beliefs with an overall mean of 4.24 (SD=.774). This suggests that Indigenous people (IP) mathematics teachers have a firm footing in their beliefs about the nature of mathematics and beliefs about mathematics teaching and learning. According to Charalambous (2015), teachers' decisions and actions in the classroom are influenced by their knowledge and beliefs. The high level of belief is a good indicator of a good learning environment provided to the IP learners since the IP mathematics teachers are more likely to respond constructively to the varying needs of each IP student. The finding of this study is parallel to that of Yang et al. (2020), which reported that mathematics teachers have a strong propensity to hold a constructivist belief rather than a traditional view. Moreover, the high beliefs about mathematics teaching and learning display a certain degree of psychological strength among IP mathematics teachers.

3.2 Level of Indigenous People (IP) Mathematics Teachers' Teaching Practices

Teaching practices refer to educators' specific actions, strategies, and methods to facilitate learning, engage students, and achieve instructional goals. These practices include lesson planning, instructional delivery, classroom management, assessment, and feedback. Table 3 presents the IP teachers' level of teaching practices.

Table 3. Level of Indigenous People (IP) mathematics teachers' teaching practices

Item No.	Indicator	Mean	SD	Description
1.	I attend staff meetings to discuss the vision and mission of the school.	4.49	0.612	Very High
6.	I ensure common standards in evaluation for assessing students' progress in Mathematics.	4.36	0.638	Very High
7.	I engage in discussions about the learning development of specific students in mathematics	4.36	0.716	Very High
12.	I discuss and coordinate homework practice across subjects.	4.32	0.732	Very High
2.	I am part in the development of our school curriculum specifically in Mathematics.	4.17	0.752	High
4.	I exchange Mathematics teaching materials with colleagues.	4.17	0.741	High
11.	I engage in joint activities across different classes and age groups (e.g., projects).	4.15	0.808	High
5.	I attend team conferences for the age group I teach in Mathematics.	4.06	0.764	High
3.	I discuss and decide on the selection of Mathematics instructional media (e.g., textbooks, exercise books) with my colleagues.	4.01	0.778	High
8.	I teach jointly as a team in the same class.	4.01	0.767	High
9.	I take part in mathematics professional learning activities (e.g., team supervision).	4.01	0.863	High
10.	I observe other mathematics teachers' classes and provide technical assistance.	3.74	1.018	High
	Overall	**4.15**	**0.794**	**High**

It can be seen from Table 3 that item 1, "*I attend staff meetings to discuss the vision and mission of the school,*" garnered the highest mean (M=4.49, SD=.612) with a description equivalent of "*very high*." This implies that IP mathematics teachers actively participate in school planning to achieve the institution's vision and mission. Through attending meetings, IP mathematics teachers can have a shared understanding and alignment of the institution's vision and mission, foster communication and engagement, and establish decision-making and accountability. This study result supports Hargreaves and Fullan (2012), emphasizing the importance of collaboration and collective decision-making in achieving school improvement. Furthermore, they discuss the role of meetings in fostering a shared understanding of the vision and mission, promoting professional learning communities, and mobilizing collective action towards common goals.

Additionally, table 3 depicts that item 6, "*I ensure common standards in evaluation for assessing students' progress in Mathematics,*" and item 7, "*I engage in discussions about the learning development of specific students in mathematics,*" received the second highest mean of 4.36 (SD=.638 and .716 respectively). This suggests that IP mathematics teachers maintain a standard reference for assessing students' learning outcomes. In addition, discussions about students' learning development, such as consultations and one-to-one conferences, were observed by the IP mathematics teachers. This is supported by Winstone and Carless (2019), who explored the role of feedback in promoting student engagement, motivation, and self-regulated learning. Moreover, Hattie and Timperley (2007) highlight the importance of timely, specific, and actionable feedback and its role in enhancing student achievement.

In contrast, item 10, "*I observe other mathematics teachers' classes and provide technical assistance,*" received the lowest mean of 3.74 (SD=1.018). Although this item still has a descriptive equivalent of "*high,*" it is understandable that it got the lowest mean since only the Master Teachers are required to conduct regular classroom observation. Even though teachers are encouraged to observe the best teaching practices of their colleagues, teachers still don't have the tendency to observe the classes of others if not required. Stronge (2018) explores various qualities and practices of effective teachers, including the significance of classroom observations for professional growth and development. Further, he emphasizes the role of observations in self-reflection, feedback, and continuous improvement.

Also shown in Table 3 that item 3, "*I discuss and decide on the selection of Mathematics instructional media (e.g., textbooks, exercise books) with my colleagues,*" item 8, "*I teach jointly as a team in the same class,*" and item 9, "*I take part in mathematics professional learning activities (e.g., team supervision),*" obtained the second lowest mean of 4.01 with standard deviation 0.778, 0.767, and 0.863 respectively. Even though these items received a relatively low score compared to other items, their descriptive equivalent is still high, which indicates that IP mathematics teachers still observe these items.

In general, table 3 depicts the IP mathematics teachers' level of teaching practices as high, with a mean of 4.15 and a standard deviation of .794. Generally, this finding suggests that IP mathematics teachers actively participate in activities that promote the achievement of the school's vision and mission, partake in professional development activities to improve teaching and learning, especially in mathematics, and be involved in peer mentoring opportunities to share and exchange best teaching practices. This finding is consistent with that of Evardo and Abina (2023), that attending professional development events fosters a more robust teaching-learning environment, keeps participants current on instructional techniques, and motivates them to progress as teachers in the twenty-first century.

3.3 Relationship between the Indigenous People (IP) Mathematics Teachers' Beliefs and Their Teaching Practices

Understanding the dynamics of mathematics education within Indigenous communities requires a thorough understanding of the interplay between the beliefs and teaching practices of Indigenous People (IP) math teachers. Indigenous people (IP) teachers bring their unique cultural perspectives, experiences, and beliefs into the classroom, which can significantly influence their teaching practices. The correlation between Indigenous people (IP) mathematics teachers' beliefs and their teaching practices is presented in Table 4.

Table 4. Correlation between Indigenous People (IP) mathematics teachers' beliefs and their teaching practices

Variable	M	SD	r	p	Remark
Beliefs	4.24	0.774	.481	<.001	Significant
Teaching Practices	4.15	0.794			

The correlation result between beliefs and teaching practices among Indigenous People (IP) Mathematics teachers, as illustrated in Table 4, indicates a significant moderate positive relationship between the two variables, $r(113) = .481$, $p < .001$. This finding suggests that there is a meaningful association between the beliefs held by IP Mathematics teachers and the teaching practices they employ in their classrooms. This further implies that as the strength or alignment of teachers' beliefs with certain principles, approaches, or cultural perspectives increases, their teaching practices tend to align more closely with those beliefs. This finding highlights the interconnectedness between teachers' underlying beliefs and their instructional strategies. Furthermore, the positive correlation suggests that teachers who clearly understand the connections between their beliefs and teaching practices are more likely to enact those beliefs in the classroom. This alignment can lead to more effective and culturally responsive mathematics instruction for Indigenous students, promoting their engagement, motivation, and academic success. However, it is essential to note that this correlation does not imply causation. While the findings indicate a relationship between beliefs and teaching practices, other factors, such as professional development, institutional support, and contextual influences, may also shape teaching practices among IP Mathematics teachers.

The study's findings add to those of Aljaberi and Gheith (2018), who found a statistically significant association between teachers' beliefs and their instructional strategies. Similarly, the study of Çam (2015) highlights how teachers' teaching practices can be influenced by their epistemological beliefs. Šapkova (2014) and Memnun & Hart (2012) also highlight the positive association between teachers' beliefs and their teaching practices. On the contrary, the study of Shi et al. (2014) supports the belief that teachers' instructional practices may not reflect teacher beliefs and found that there were no regular patterns of the relationship between teachers' beliefs and their instructional practices because teachers' actions were neither consistent nor in line with their beliefs about education. The findings of this study highlight the complexity and multifaceted nature of the relationship between teachers' beliefs and their teaching practices. Further, this complexity and multifaceted relationship emphasizes Bronfenbrenner's (1979) Ecological Systems Theory which explains that a range of environmental factors, such as personal, cultural, and contextual factors, can influence teacher beliefs. The interplay of these factors differs from teacher to teacher, which explains the varying levels of teachers' beliefs in teaching. These varying beliefs, in turn, create a diverse teaching practice.

3.4 Indigenous People (IP) Mathematics Teachers' Beliefs and Practices in Teaching Mathematics

The beliefs and practices of Indigenous People (IP) Mathematics teachers in teaching mathematics play a significant role in shaping the educational experiences of Indigenous students. Understanding these beliefs and

practices is crucial for developing culturally responsive and effective mathematics instruction. Table 5 shows the emerging themes of beliefs and practices with their corresponding core ideas.

Table 5. Themes on Indigenous People (IP) Mathematics teachers' beliefs in teaching mathematics

	Themes	Core Ideas
On Beliefs	Qualities of an effective mathematics teacher	Content knowledge expert Setting of clear objectives and rules Openness to feedback
	Respect to students' culture and background	Culturally responsive teaching Ensures applicability and relatability of concepts
	Constructivist approach to teaching	Fun and engaging learning environment Maintaining good relation and safe environment
On Teaching Practices	Discussion of student performance and intervention during meetings	Collaborative planning for possible solutions and interventions
	Teaching practices of IP mathematics teachers	Implementing culturally relevant approach Utilization of technology and varied activities
	Benefits of peer mentoring and coaching	Provide assistance Identifying strengths and areas for improvement

Theme 1: Qualities of an Effective Mathematics Teacher

The beliefs of IP Mathematics teachers regarding the traits of an effective mathematics teacher are highlighted in this theme. IP mathematics teachers acknowledge how crucial it is to have a solid grasp of the subject's content. They believe a teacher should thoroughly understand mathematical theories, concepts, and problem-solving strategies. This belief is encapsulated in the responses of the participants.

"… the teacher is knowledgeable enough and supportive. The teacher should be able to explain the concepts well in his/her class." – IDI003

"… possesses deep content knowledge" – IDI004

"… a teacher organize mathematical knowledge around its core concepts." – IDI002

According to another participant, expertise in content knowledge is not enough. An effective teacher must possess empathy, communication skills, and flexibility. This is captured in the statement:

"… string pedagogical skills, patience and empathy, good communication skills and flexibility and adaptability" – IDI004

Stronge (2108) asserts that teachers have a significant, long-lasting impact on their students because they directly impact what students learn, how much they learn, how students acquire it, and how they interact with their environment. Producing globally competitive students thus requires highly competitive teachers who are effective in knowledge, instructional delivery, assessment, learning environment, and professionalism. Moreover, the participants' beliefs of an effective teacher are consistent with Huang and Napier's (2015) results that effective teachers affect students' learning processes and paths to professionalism through their personalities and content knowledge is the subject.

Additionally, participants also believe that an effective teacher is prepared and, thus, is able to set clear objectives and rules. This concept is seen in the participants' responses.

"Before I enter the room, I always prepare the activities" – IDI001

"([It is important] that the teacher must clearly establish the class objectives. In this day, in this specific session, these are the target that we need to achieve." – IDI003

"clear and understandable rules that are consistent with instructional goals" – IDI004

Before entering the classroom, teacher preparation is of the highest importance since it is essential to ensure that educators are prepared to meet the differing needs of students and deliver effective instruction. Furthermore, teacher preparation ensures content knowledge and expertise, planned and seamless classroom activities, and good classroom management. An unprepared teacher may find himself/herself with no idea what to do inside the classroom and, in turn, find it challenging to manage the classroom since there is no prepared, structured activity. Starkey (2019) posed a challenge to teachers, noting that as schools and teaching change due to the incorporation of technologies, so too will teacher preparation. Teachers may allot more time to try and test new relevant technologies in their teaching. In addition, Brudvig et al. (2022) noted that goal setting increases student motivation and yields positive outcomes in terms of academic achievement.

Participants also noted that being open to feedback and constructive criticism is one of the qualities of an effective teacher. A participant noted that:

"… be open to feedbacks both from students and co teachers" – IDI004

"… I always welcome input from my students and coworkers in order to enhance my teaching approaches" – IDI004

Feedback and constructive criticism are essential to IP Mathematics teachers since they provide development opportunities. They think that by being receptive to criticism from administrators, students, and colleagues, they may improve their instructional strategies and become more effective teachers. In their study, Fong et al. (2018) highlighted that when someone is criticized, they frequently see it as a sign of failure, but this may be avoided with good communication. They also emphasized that criticism needed to be perceived as coming from a trustworthy source and that the feedback message required the qualities of being well-intended, focused, and offering suggestions for improving the work. Additionally, according to Faisal et al. (2019), a lack of effective two-way communication between faculty and administration contributes to teacher workplace stress. They stated that teachers feel abandoned and ignored due to the lack of supportive feedback and constructive criticism.

Theme 2: Respect for Students' Culture and Background

This theme's emphasis is on the beliefs of IP Mathematics teachers regarding the significance of respecting and acknowledging students' cultural identities and backgrounds. Based on the participants' responses, they believe that teaching in an Indigenous community should be delivered in a culturally responsive approach. This can be observed in the narratives of the participants.

"… classroom setting is inclusive and culturally responsive, acknowledging and valuing the diverse background and experiences of all students." – IDI004

According to Edilo et al. (2022), a way of making the classroom culturally responsive is by contextualizing the examples and using the students' local language so that the concept being presented makes more sense to the students' daily lives. Narratives among the participants shared the same belief as attested in their responses.

"(Your style should be contextualized, localized, and indigenized so that they will understand the concept." – IDI003

"You should make them understand and you should also know their language" – IDI003

Cruz et al. (2019) state that culturally responsive teaching can positively affect student outcomes. If the students can connect the concepts being taught and their real-world, concepts are concretized, and learning is permanent. With that, IP mathematics teachers believe that mathematical principles should be used in real-world contexts, especially those pertinent to Indigenous populations. They support emphasizing the usefulness of mathematics and its importance to Indigenous students' daily lives. This notion is captured by the participants sharing.

"The students should be able to apply the concepts learns at school to their own lives." – IDI003

"… in a way that students will practice [the concepts] in real life" – IDI005

In the study of Reyes et al. (2019), they underlined that if mathematics lessons were designed based on students' context, it makes the lessons more meaningful and relevant to the students. Additionally, doing so makes the class

lively and engaging, where students construct meaning. They also reported that participants believe that the meaning of contextualization is about the student's culture and background and using local materials or information.

Participants also believe that by applying culturally responsive pedagogy and ensuring the concepts' applicability and relatability, they will be able to produce quality students, which makes their learning into innovative and productive ideas. A participant has shared that:
"… you can produce quality students which have learned something from your class, and they can apply it in their homes and lives." – IDI003

Being able to apply the concepts in real life is already a milestone, but teachers should also consider the development of other equally essential life skills. Baird and Parayitam (2019) pointed out that the top six skills employers seek are interpersonal, problem-solving, listening, communication, professionalism, and motivation.

Theme 3: A Constructivist Approach to Teaching
This theme reflects the beliefs of IP Mathematics teachers about adopting a constructivist approach to teaching and learning. The core ideas include (1) a fun and engaging learning environment and (2) maintaining good relations and a safe environment. IP mathematics teachers believe fostering a fun and engaging learning environment is essential. They understand the importance of actively combining interactive techniques, group projects, and hands-on activities to engage students in the learning process. This notion is observed in the participants' responses.

"… always be a pupil-centered or a student-centered educator" – IDI002

"in class, it should not the be teacher who is always giving inputs. We should also include our dear students to ensure conducive learning environment" – IDI003

Participants shared that a constructivist classroom provides an engaging environment and fun and varied activities. The participants said that:

"… you see the students engage in the activities, and responds to the teacher's questions" – IDI001

"… shows positive and engaging environment for his/her students" – IDI003

"group discussions where they can provide a space for learners to share their ideas and perspectives with each other to learn from their classmates insights" – IDI004

"… I use various teaching strategies because students have multiple intelligences" – IDI003

Many studies worldwide have underscored the positive effect of applying a constructivist approach to teaching and learning compared to the traditional approach. Ginga and Zakariya (2020); Voskoglou (2019); and Ibañez and Pentang (2021) have reported increased mathematics performance, improved student attitudes, promoted social behavior, and increased student participation. Moreover, the findings of this study are similar to that of Kusaeri and Aditomo (2019), which found that most pre-service teachers preferred the constructivist approach over the traditional one. However, according to Shah (2019), the constructivist approach in education has frequently been misapplied, leading to instructional strategies that neither challenge students nor meet their demands. This highlights that teachers must be updated on the recent developments in constructivist teaching and learning to avoid the misuse of the approach and ensure authentic student learning and achievement.

Aside from the IP teacher's belief in the advantages of applying the constructivist approach, they stressed the importance of providing the students with a safe, nurturing, and nonjudging environment while learning. This is seen from the participant's accounts as follows:
"Consider that the learning environment is positive and inclusive." – IDI003

"The classroom should be safe and welcoming. The students should feel they welcome inside the classroom" – IDI003

"*Use specific positive action words*" – IDI004

"*Establish working relationship with students*" – IDI004

The IP teachers' belief in providing students with a positive learning environment supports the study of Sithole (2017), which asserted that Students achieve the desired results when there is a caring environment in the educational setting. The schools can either assist students in getting excellent results, or they could result in the students failing. Positive learning environments that also equate with strong teacher/student connections improve student performance. Moreover, O'Malley et al. (2015) exclaimed that students who self-reported stronger academic performance also self-reported perceptions of a more positive school climate, regardless of family structure. Furthermore, the moderating impact of positive school climate perceptions on self-reported academic performance was largest for homeless adolescents and youth from one-parent families, indicating that school climate has a protective impact on students from these family types. The result emphasizes the importance of teachers serving as second parents in the classroom. The goal of the classroom environment should be to make students feel comfortable.

Table 5 also presents the themes of Indigenous People (IP) mathematics teachers' Practices in teaching mathematics. These themes and core ideas highlight the pedagogical strategies used by IP Mathematics teachers. It is crucial to understand these practices in order to create math lessons for Indigenous students that are culturally appropriate. By adhering to these teaching practices, teachers can encourage meaningful learning, encourage student involvement, and support Indigenous students' academic achievement.

Theme 4: Discussion of Student Performance and Intervention During Meetings

The theme highlights the practices of IP Mathematics teachers in examining student performance and intervention strategies during meetings. Due to the varying needs of each IP student, the teachers have developed a culture of discussing students' performance and needs and sharing and proposing best practices to help the IP students. Moreover, the participants also shared that these discussions happen not only during formal meetings but also during casual conversations. These practices were captured in the participant's responses as follows:

"In our meetings, we point out those students who need assistance … then we give solution." – IDI007

"All of the teachers discussed the possible ways to improve the students' low performance in mathematics" – IDI008

"Informally, during our lunch time, we talk about the challenges and problems of our students" – IDI008

These conversations on student performance and finding a viable solution to student problems are consistent with the IP mathematics teachers' belief in providing the learners with a safe and welcoming environment. This highlights the teachers' compassion toward their students which is one of the attributes of an effective teacher. Jazaieri (2018) argued that while parents and family systems serve as excellent models of compassion for young children, compassion may also be demonstrated to students in a classroom setting. This finding demonstrates that teachers have the chance to foster the development of compassion in each student at various points throughout the educational spectrum.

Theme 5: Teaching Practices of IP Mathematics Teachers

Based on the interviews, culturally responsive teaching strategies are given priority by IP Math teachers. They incorporate Indigenous culture, customs, and examples into their instruction to make the subject matter more relevant to their student's lives and experiences. The participants' narratives reveal this idea.

"… we contextualize the teaching of mathematics, so that they can picture out their understanding of the topics because they have experienced it already. We use the things available in the surroundings so that they will learn." – IDI006

"The teachers should translate his/her instruction into the students' local language so that they will understand it. The teacher should learn to speak and understand the local language." – IDI008

"It should be fit to the lesson. For an instance, instead of using weighing scale 'gantang' or 'gantangan' should be used for it to be localized." – IDI010

This teaching practice is consistent with the IP mathematics teachers' belief in providing students with culturally responsive teaching and learning experience. This teaching practice is consistent with Cruz et al. (2019), who see positive learning outcomes among the students who are taught using a culturally responsive approach. Moreover, the practices of the IP mathematics teachers are parallel to the report of Edilo et al. (2022), which found that teachers who implement culturally responsive pedagogy use the local language of the students for better understanding; and use local and readily available resources in teaching so that students can easily understand the concepts being presented.

Moreover, besides implementing culturally responsive teaching, IP mathematics teachers try to introduce technology and manipulatives to their students. Recognizing the importance of technology in 21st-century teaching and learning, IP mathematics teachers see to it that their students are exposed to technologies to be at par with those students who live in urban areas. This is captured in the answers of the participants as follows:

"… I integrate ICT during my mathematics class because it captivates the attention of the students" – IDI008

"I also use technological advancements like smart tv. I download educational videos and play it during class. The videos easily catches the attention of the students" – IDI006

A meta-analysis conducted by Higgins et al. (2017) indicates a significant overall impact of technology on student achievement, motivation, and attitudes in mathematics. Furthermore, Ran et al. (2021) found a statistically significant effect between technology use and math achievement. They also discovered that technology was employed to enhance mathematical communication, problem-solving, conceptual growth, and practices for adaptive mathematics. However, Young et al. (2018) contended that when integrating technology in the classroom, teachers must consider grade level, time, and the instructional function of technology.

Moreover, since the IP mathematics teachers believe that their approach to teaching is constructivist, it shows in their practices by employing varied activities and teaching strategies. Further, the IP mathematics teachers provide varied activities to cater to the students' multiple intelligences. The participants said that:

"[use] varied teaching strategies and activities; if you used board work today, tomorrow use another approach." – IDI008

"I conduct interventions like drills, home visitation, tutorials, and focus group discussions." – IDI006

"We use manipulatives and often times media." – IDI009

"You need to relate the concept to real-life to cater the students' multiple intelligence. My strategy is applying differentiated instruction." – IDI008

Prast et al. (2018) stated that implementing differentiated instruction can potentially promote student achievement. Awofala and Lawani (2020) reported a significantly improved performance for those students exposed to differentiated instruction than for those who were not. Additionally, they observed that differentiated instruction encouraged student participation and made lessons more exciting and stress-free. Also, Lai et al. (2020) found that varied teaching and learning activities significantly increased students' mathematics self-efficacy, learning motives, and problem-solving skills.

Theme 6: Benefits of Peer Mentoring and Coaching

Peer mentoring and coaching support and guide IP Mathematics teachers in their professional growth. They offer a platform for sharing experiences, resources, and strategies to enhance teaching effectiveness. The participants said that:

"…to give assistance on our weaknesses, to be improved, and to able to give quality education to our students." – IDI006

"… my chance to gain technical assistance on how to improve my teaching strategies." – IDI009

"My colleague ask for an idea about his/her topic and I was able to impart idea." – IDI007

Aside from providing assistance, teachers also appreciate classroom observations since peer mentoring and coaching enable IP Mathematics teachers to recognize their strengths and areas for development through constructive criticism and self-reflection. This idea is seen in the responses of the participants.

"There is no best teaching strategy but if you are willing to be observed and open for comments, you can improve your teaching strategy since we can always learn from others." – IDI008

"… it is an opportunity to be observed by a school head or a teacher because I do believe that through their observation, they can give technical assistance on my strengths." – IDI006

"Through their inputs, comments, and support, I will know where the areas are that needs revision in my teaching strategy." – IDI008

Studies have shown that peer coaching and mentoring positively affect teachers' and their students' performance. Hsieh et al. (2019) reported that students in peer-coached teachers' classes had more favorable views of their teachers' instructional strategies and performed better regarding their scientific competency. Additionally, teachers felt peer coaching sessions inspired them to adopt science literacy-based lessons and advance their assessment skills. Bell et al. (2019) discussed the advantages of peer mentorship, including using research-based teaching techniques, encouraging collegial conversations, and reflection in the teaching workplace context.

More importantly, peer mentoring and coaching create opportunities for IP mathematics teachers to learn from the expertise and experiences of their colleagues. With that, it boosts their confidence and confidence. This is captured from the sharing of the participants.

"I believe that even if how long you are in the field there are things that you need to learn." – IDI006

"… [by observing] them, there are things that you can learn like the way they handle their class in mathematics." – IDI008

"… when you feel the support and assistance of your colleagues on your plans, it encourages you to do better … it can boost your morale." – IDI008

The findings of this study matched that of Carlson et al. (2020), that through peer coaching, teachers can be aware of unrecognized habits, provided personalized tips to improve teaching quality based on individual style, and exposure to new teaching techniques. Overall, the IP mathematics teachers clearly understand the need for classroom observations and peer mentoring sessions. They engage in such professional development activities with the primary goal of helping the students in need and further enhancing the teaching and learning experience of the IP students, especially in Mathematics.

3.5 Data Integration of Salient Quantitative and Qualitative Results

Table 6 shows how the qualitative data explains the quantitative data gathered on the beliefs and teaching practices of the IP mathematics teachers. It can be seen in Table 6 that the most salient quantitative and qualitative findings are parallel and support each other. However, one quantitative result, specifically on teaching practices, seems to have conflicting results with its corresponding qualitative finding.

Based on the findings, the IP mathematics teachers believe that an effective teacher demonstrates the correct way to solve a problem (M=4.71). This result coincides with the theme, "*Qualities of an effective mathematics teacher.*" According to the responses of the participants, they believe that an effective mathematics teacher knows how to demonstrate the correct way to solve a problem since that teacher is a content knowledge expert, knows how to

set clear objectives and rules, and is open to constructive feedback. Moreover, the study respondents believe instruction should be built around problems with clear, correct answers and ideas that most students can grasp quickly (M=4.59) parallel to the theme, "*Respect for students' culture and background*." The participants believed that an effective teacher employs culturally responsive pedagogy and ensures the applicability and relatability of the concepts being presented. Through culturally responsive teaching, students are familiar with the concepts, thus making learning more relatable and permanent.

Table 6. Joint display of salient quantitative and qualitative data

	Quantitative Data Findings	**Qualitative Data Findings**	**Data Integration Nature**
On Beliefs	Table 2 reported the highest means on the following: Item 1: I believe that, in teaching mathematics, an effective or good teachers demonstrate the correct way to solve a problem. (M=4.71) Item 7: I believe that, in teaching mathematics, instruction should be built around problems with clear, correct answers, and around ideas that most students can grasp quickly. (M=4.59)	Table 5, On beliefs theme: Qualities of an effective mathematics teacher Respect to students' culture and background	Supporting Supporting
	Table 2 reported the lowest means on the following: Item 5 : I believe that, in teaching mathematics, teachers know a lot more than students; they shouldn't let students develop answers that may be incorrect when they can just explain the answers directly. (M=3.77) Item 11: I believe that, in teaching mathematics, a quiet classroom is generally needed for effective learning. (M=3.86)	Constructivist approach to teaching	Supporting
On Teaching Practices	Table 3 reported the highest means on the following: Item 1: I attend staff meetings to discuss the vision and mission of the school. (M=4.49) Item 7: I engage in discussions about the learning development of specific students in mathematics. (M=4.36)	Table 5, On teaching practices theme: Discussion of student performance and intervention during meetings Benefits of peer mentoring and coaching	Supporting
	Table 3 reported the lowest means on the following: Item 10: I observe other mathematics teachers' classes and provide technical assistance. (M=3.74)		Contrasting

In contrast, the participants have less agreement, or they do not believe that teachers know a lot more than students; they should not let students develop answers that may be incorrect when they can just explain the answers directly (M=3.77). Additionally, they do not generally believe that a quiet classroom is generally needed for effective learning (M=3.86). This is supported by the theme, "*Constructivist approach to teaching*." The theme suggests that teachers believe applying a constructivist approach to teaching and learning is the way forward. In this approach, the teacher is not the fountain of knowledge. Instead, the teacher facilitates while the students are actively learning. With this type of learning, students actively participate in activities; thus, they believe that a quiet classroom does not necessarily equate to learning. Moreover, the IP mathematics teachers believe that the students must be placed in a safe and welcoming environment conducive to learning.

On teaching practices, the IP mathematics teachers attend staff meetings to discuss the vision and mission of the school (M=4.49) and engage in discussions about the learning development of specific students in mathematics (M=4.36). The theme can explain the high ratings on these items, "*Discussion of student performance and intervention during meetings.*" Participants revealed that collaborative planning for possible solutions and interventions is a must in every educational institution. Every teacher should take part in realizing the mission and vision of every school, and that is to produce globally competitive individuals who will positively impact society.

Lastly, participants rated the item "*I observe other mathematics teachers' classes and provide technical assistance*" as the lowest, with a mean of 3.74. This result seems to conflict with the qualitative finding on "*Benefits of peer mentoring and coaching*." Based on the interviews with the participants, they highly value cooperation and collaboration, hence seeing the need, importance, and benefits of peer mentoring and coaching. This conflict might be attributed to teachers, especially from government schools, being observed only by the master teachers, head teachers, and principals. Although teachers of the same level do not observe each other, they devised a mechanism to still learn from each other, and that is by sharing their best practices.

Overall, a meaningful relationship exists between the study variables, as evidenced by the positive association between the IP mathematics teachers' beliefs and teaching methods. The qualitative findings supporting this association show how IP mathematics instructors' beliefs were put into practice. This connection serves as further evidence of the importance of comprehending and supporting the views of IP Mathematics teachers in order to promote effective and culturally responsive mathematics instruction for Indigenous students. By recognizing and leveraging the interconnectedness between teachers' beliefs and their instructional practices, educators and policymakers can promote sustainable and empowering learning experiences for Indigenous students.

4.0 Conclusion

This study reveals a cyclical relationship between teachers' beliefs and their practices within the classroom. Environmental factors significantly shape how strongly teachers hold specific beliefs about teaching and learning. These beliefs then serve as a roadmap for the instructional practices they implement. The study found a tendency for teachers with stronger constructivist beliefs to utilize culturally responsive pedagogy, focusing on contextualization and leveraging students' native languages. These highlight the importance of fostering constructivist beliefs in teachers. Furthermore, the research emphasizes the value of professional development activities like peer mentoring and coaching. These programs provide opportunities for IP teachers to stay up-to-date on best practices, share successful strategies with colleagues, and boost their overall morale and confidence. More importantly, this research underscores the interconnectedness between teachers' beliefs, practices, and professional development. By acknowledging this cyclical relationship, school leaders and educators can work together to create ongoing support systems that empower IP teachers to refine their pedagogical approaches, strengthen their constructivist beliefs, and ultimately create culturally relevant and engaging learning environments for all students..

Moving forward, targeted professional development programs can be instrumental in solidifying constructivist teaching beliefs among teachers. Workshops, seminars, or online courses specifically designed to explore constructivist principles and their practical application in the IP classroom can provide valuable support. Also, training in culturally responsive pedagogy can equip IP teachers with the necessary tools and strategies. This training can empower them to integrate students' cultural backgrounds and native languages into the curriculum, fostering a more inclusive learning environment for all students. Furthermore, the study highlights the value of expanding peer coaching and mentoring programs within schools. These programs provide a platform for IP teachers for constructive feedback in a supportive environment. Finally, supportive school leadership that prioritizes ongoing professional development and teacher collaboration is crucial. By creating a culture that values continuous learning and shared responsibility for student success, school leaders can empower teachers and cultivate a strong foundation for ongoing improvement.

5.0 Contributions of Authors

The authors declare equal contribution in the conceptuaization, data gathering, and writing of the manuscript.

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The author declare no conflicts of interest.

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