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KNOWLEDGE FOR TEACHING MATHEMATICS TO STUDENTS WITH SPECIAL EDUCATION NEEDS WITH LEARNING DISABILITIES: A NEED ANALYSIS

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ABSTRACT

Teaching mathematics to students with special educational needs (SEN) demands specialized pedagogical competencies beyond general teaching skills. However, previous studies indicate that many special education teachers lack sufficient training specifically in mathematics pedagogy, hindering their ability to address the learning challenges of SEN students. This study addresses the identified gap in understanding teachers' perceptions regarding the specific pedagogical knowledge necessary for effective mathematics instruction for SEN students, alongside evaluating teachers' actual knowledge and experience levels in this domain. Employing a quantitative survey research design, data were collected through an online questionnaire involving 30 Special Education Integration Program (SEIP) teachers from various schools in Sarawak selected through convenience sampling. Data were analysed using descriptive statistics in SPSS, and the reliability of the instrument was assessed using Cronbach's alpha coefficient. Findings highlight that, despite adequate general pedagogical preparedness, teachers remain less confident in their mathematics-specific instructional competencies. Therefore, the study concludes with a recommendation for more structured and targeted professional training in mathematics pedagogy. This research offers valuable insights to stakeholders aiming to enhance special education training programs, thereby improving instructional effectiveness for SEN students.

Keywords: Special Education, Mathematics Instruction, Students with Special Educational Needs, Teacher Knowledge, Mathematics Pedagogy

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INTRODUCTION

Teaching mathematics to students with SEN remains a significant issue in special education, despite ongoing initiatives aimed at improving teachers' instructional effectiveness. In Malaysia, special education teachers have generally been well-trained in broad pedagogical approaches. However, challenges persist specifically in mathematics instruction. Many special education teachers struggle to effectively adapt mathematics instruction due to insufficient specialized training tailored explicitly to teaching mathematics to students with SEN (Mahmud et al. 2023). This limitation often leads to difficulties in delivering mathematical content that aligns with the cognitive and developmental needs of these students (Sheppard & Wieman 2020).

Research consistently highlights that having strong general teaching skills alone is insufficient when addressing the specific challenges in teaching mathematics to students with SEN. While general pedagogical training equips teachers with basic instructional strategies, gaps remain in their content-specific knowledge particularly mathematics required to address the distinct learning barriers faced by SEN students (Bakar & Tahar 2019). These gaps can adversely affect students' ability to grasp fundamental mathematical concepts, thus limiting their academic progression and cognitive development. Although previous studies have acknowledged these challenges, there remains limited research explicitly examining the specific pedagogical and content knowledge that special education teachers perceive as necessary and the extent to which they possess such knowledge, particularly within the Malaysian context, including Sarawak.

Therefore, this study aims to fill this identified research gap by explicitly analyzing special education teachers' perceptions regarding the essential pedagogical and mathematical content knowledge required for effective instruction of mathematics to students with SEN, specifically those with learning disabilities. Additionally, the study assesses teachers' actual knowledge levels and teaching experiences related to mathematics instruction within the special education context. The findings of this research are expected to provide clear insights and practical guidance for stakeholders such as policymakers, teacher training institutions and school administrators in Malaysia, enabling the design and implementation of targeted professional development programs. Such efforts will potentially improve instructional quality, fostering better mathematics learning experiences and outcomes for SEN students.

LITERATURE REVIEW

Effective teaching of mathematics to students with SEN, particularly those with learning disabilities, demands a balanced combination of pedagogical and content knowledge specific to mathematics instruction. Research in special education consistently emphasises that a teacher's depth of understanding of mathematics, combined with their ability to apply effective instructional strategies, significantly influences SEN students' academic outcomes (Bakar & Tahar 2019; Mahmud et al. 2023). However, numerous studies have highlighted persistent deficiencies in mathematics-specific knowledge among special education teachers, revealing critical gaps that directly impact their instructional quality (Roos 2019; Sheppard & Wieman 2020).

The theoretical foundations for effective mathematics instruction to SEN students are deeply rooted in constructivist theories, notably those advanced by Piaget (1970) and Vygotsky (1978). Piaget's cognitive development theory underscores the necessity for teaching mathematics through concrete and experiential learning approaches, aligning closely with the cognitive developmental stages of learners. For SEN students, concrete experiences using

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manipulatives are particularly important, facilitating smoother progression to symbolic and abstract mathematical understanding (Piaget 1970). Complementing Piaget, Vygotsky's socio-cultural theory, specifically the concept of the Zone of Proximal Development (ZPD), highlights the role of guided instructional interactions between teachers and learners. According to Vygotsky (1978), effective learning occurs when students engage socially and collaboratively with more capable peers or teachers, thus enabling the acquisition of higher-order mathematical thinking skills, which are often challenging for SEN students without structured guidance.

Integrating these theoretical perspectives, Shulman's (1987) Pedagogical Content Knowledge (PCK) model provides a comprehensive framework for understanding teacher knowledge. Shulman argues that effective teaching is achieved when teachers seamlessly integrate content knowledge (CK) with pedagogical strategies tailored specifically to students' learning needs. In mathematics education for SEN students, PCK involves not only mastery of mathematical content but also the strategic adaptation of teaching methods to accommodate diverse learning styles and cognitive capabilities (Bakar & Tahar 2019; Thai & Yasin 2019). Empirical studies reinforce Shulman's framework, demonstrating that teachers with robust pedagogical content knowledge in mathematics can effectively identify and respond to students' learning difficulties through tailored instructional approaches (Thai & Yasin 2019).

Despite strong theoretical support, many empirical studies reveal that special education teachers frequently lack comprehensive training in specialized mathematics pedagogy (Roos 2019; Mahmud et al. 2023). For example, Roos (2019) found that many special education teachers reported difficulties translating their general pedagogical knowledge into mathematics-specific instructional practices, resulting in students' poor comprehension of fundamental mathematical concepts. Similarly, Khalil et al. (2020) reported that special education teachers in Malaysia often have insufficient practical training, highlighting specific challenges such as inadequate understanding of appropriate teaching aids and limited instructional flexibility. These findings align with Seriayuna (2019), who identifies additional challenges faced by teachers, including heavy workloads, inadequate resources and insufficient administrative support, all of which further complicate effective mathematics instruction for SEN students.

Moreover, research highlights that extensive teaching experience alone does not necessarily ensure effective mathematics teaching. Teachers may accumulate years of general teaching experience yet remain insufficiently prepared to deliver specialized mathematics instruction without targeted professional development (Mahmud et al. 2023; Sheppard & Wieman 2020). For instance, Mahmud et al. (2023) observed that while experienced teachers could manage classroom behaviors and implement general instructional strategies effectively, they frequently lacked confidence and skills in addressing mathematics-specific learning difficulties. Sheppard and Wieman (2020) similarly noted that specialized training in mathematics pedagogy was essential for teachers to effectively meet the instructional demands posed by SEN students.

Given these identified challenges, a clear consensus emerges from the literature on the importance of targeted professional training and continuous professional development specifically focused on mathematics instruction for SEN students. Khalil and Hantira (2022) advocate that effective professional development programs should encompass specialized mathematics pedagogy, integration of manipulatives and assistive technologies, alongside strategies designed explicitly to address the cognitive and developmental needs of SEN learners. Such targeted professional training can significantly enhance teachers' confidence and instructional effectiveness, ultimately leading to improved mathematics learning outcomes for SEN students (Khalil & Hantira 2022; Abu Bakar & Tahar 2019).

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In conclusion, the reviewed literature underscores the necessity of specialized mathematics pedagogical training for special education teachers. Theoretically informed, targeted professional development addressing specific instructional gaps identified in prior research appears essential to improve mathematics instruction quality for SEN students. Building on this synthesis, the present study aims to examine teachers' perceptions of essential mathematics pedagogical knowledge, assessing their current level of knowledge and experience, thus providing actionable insights for strengthening future professional training programs.

METHODOLOGY

This section describes the research approach utilized in the study, encompassing the research design, population and sampling, research instrument, as well as data collection and analysis procedures. The study employed a quantitative approach through questionnaires to gather empirical data, enabling the researcher to understand patterns and trends regarding teachers' perceptions of mathematical knowledge necessary for teaching SEN students with learning disabilities. The validity and reliability of the instrument were also assessed to ensure the accuracy of the obtained data. This study was conducted as a preliminary survey employing a quantitative approach with questionnaires serving as the primary instrument. The descriptive research design was deemed appropriate as it enables researchers to obtain a comprehensive overview of trends and patterns within a population (Creswell & Creswell 2018).

Population and Sample

The target population for this study comprised teachers currently teaching mathematics to students with SEN enrolled in SEIP across various secondary schools in Sarawak. The sample was selected using convenience sampling, primarily due to practical considerations including ease of access, cost-effectiveness and the ability to efficiently gather data within a relatively short time frame. Specifically, participants consisted of teachers who willingly responded to invitations distributed online via Google Forms. However, it is important to acknowledge the limitations associated with convenience sampling. Firstly, this method may introduce sampling bias, as respondents may not represent the broader population of SEIP teachers adequately. Secondly, the findings from this type of sampling approach might have limited generalizability beyond the immediate sample, necessitating cautious interpretation of results within wider contexts (Bryman, 2016).

A total of 30 SEIP teachers constituted the sample for this preliminary survey, which is considered adequate. According to Hill (1998), a minimum sample size of 30 is often employed in social research to provide reliable preliminary insights. Additionally, Roscoe (1975) suggested that a sample size ranging between 30 and 500 respondents is typically sufficient for most research conducted within the social sciences. In this study, a total of 30 SEIP teachers in Sarawak participated as respondents, comprising 7 male teachers (23.3%) and 23 female teachers (76.7%). Regarding age distribution, the majority of respondents were between 31–40 years old (40.0%), followed by 41–50 years (26.7%), 51–60 years (20.0%), and 21–30 years (13.3%). In terms of teaching experience, nearly half of the respondents had 11–15 years of experience (46.7%), while 20.0% had 0–5 years, another 20.0% had 6–10 years and 13.3% had 16–20 years. Regarding academic background, the majority of teachers in this study possessed special education qualifications (66.7%), whereas 33.3% did not have specialized qualifications in this area.

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Research Instrument

The research instrument used was a questionnaire adapted from the study by Sheppard and Wieman (2020), designed specifically to measure essential pedagogical and content knowledge required by mathematics teachers in special education contexts. The adaptation process involved translating and contextualizing the items to match the Malaysian special education setting, specifically accounting for cultural and educational considerations relevant to local teachers. This questionnaire comprises three main sections: section A on demographic Data, section B on teachers' perceptions of knowledge requirements in mathematics instruction for SEN students and section C on teachers' level of knowledge and experience in mathematics instruction for SEN students.

To ensure content validity, the questionnaire was reviewed and assessed by an expert in mathematics and an experienced special education teacher familiar with teaching SEN students. This review aimed to confirm that each questionnaire item accurately measures the intended constructs and is suitable for use within the special education context. According to Polit and Beck (2006), content validity can be established through evaluations conducted by academic experts and practitioners with relevant expertise in the field of study. The Cronbach's Alpha values for each section of the questionnaire instrument indicate acceptable reliability levels, with each construct falling within the range of 0.70 or higher. This aligns with the findings of Nunnally and Bernstein (1994), who suggest that Cronbach's Alpha values between 0.70 and 0.80 demonstrate sufficient internal stability for exploratory studies. Moreover, according to Fauzi et al. (2014), Cronbach's Alpha values of 0.6 and above are generally acceptable, especially in preliminary research. Therefore, the instrument employed in this study can be considered reliable for measuring SEIP teachers' perceptions and experiences regarding mathematics instruction for SEN students.

Data Collection and Analysis

Data was collected using an online questionnaire distributed through Google Forms to SEIP teachers in Sarawak. Utilizing online questionnaires enabled researchers to obtain responses more quickly and efficiently, as well as to reduce data collection costs (Bryman 2016). Participants were clearly informed about the purpose of the study, data confidentiality, and voluntary participation before completing the survey. The collected data were analyzed using descriptive statistics with SPSS software. Descriptive statistics employed included frequency, percentage, means and standard deviations, based on five- and six-point Likert scales. These measures were used to identify patterns and trends in teachers' perceptions of necessary knowledge and their experience levels in mathematics instruction for SEN students. According to Pallant (2020), descriptive statistics are particularly suitable for survey research in identifying trends and patterns within obtained data.

RESULTS AND FINDINGS

The following section presents a descriptive analysis of teachers' perceptions regarding the necessity of pedagogical knowledge, alongside the actual levels of knowledge and experience among educators in teaching mathematics to SEN students with learning disabilities, as illustrated in Table 1 and Table 2. Table 1 offers a detailed overview of teachers' perceptions concerning the essential pedagogical competencies required for effective mathematics instruction tailored to SEIP teachers. Table 2 delineates the actual levels of teachers' knowledge and experience, as measured through self-assessment. This comparative analysis provides critical insight into the

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alignment and potential disjunction between the perceived pedagogical imperatives and the realities of classroom practice, thus illuminating key areas for targeted professional development and instructional enhancement.

Teachers' Perceptions of Knowledge Requirements in Mathematics Instruction for SEN Students with Learning Disabilities

A total of seven items were evaluated by 30 participating teachers using a five-point Likert scale: not at all important, less important, moderately important, somewhat important and very important. Overall, the findings indicate that teachers hold highly positive perceptions toward the necessity of possessing pedagogical knowledge in mathematics for SEN students with an overall mean score of 4.45 and a standard deviation of 0.56. This reflects a high level of agreement and consistency among respondents regarding this construct. Based on Table 1, this section presents an analysis of teachers' perceptions regarding the importance of pedagogical knowledge in the context of mathematics instruction for students with SEN who have learning disabilities.

In detail, the first item emphasizing the importance of having strong mathematical knowledge revealed that two-thirds of respondents (20 teachers, 66.7%) rated this aspect as very important, while the remaining one-third (10 teachers, 33.3%) rated it as somewhat important. This clearly demonstrates a strong awareness among teachers of the need for solid content mastery in mathematics as a foundational element to ensure effective teaching within the special education context. The second item, which pertains to having general knowledge about how SEN students learn mathematics, also showed a high level of agreement with the majority of respondents (21 teachers, 70%) selecting very important and the remainder (9 teachers, 30%) selecting somewhat important. These findings highlight the necessity of understanding students' learning styles in depth as this knowledge enables teachers to plan instructional strategies aligned with the diverse needs of SEN learners. Furthermore, the third item concerning the importance of knowing each student individually also recorded a high level of agreement with 21 respondents (70%) choosing very important and 9 respondents (30%) choosing somewhat important. These figures reflect the recognition among teachers of the importance of an individualized approach in teaching SEN students as specific understanding of each student's needs is fundamental to successful learning outcomes. Notably, the fourth item stressing the importance of understanding the specific challenges SEN students face in learning mathematics received unanimous agreement, with all 30 respondents (100%) rating it as very important. This finding is particularly significant, as it demonstrates a comprehensive awareness among teachers of the need to understand the specific mathematical learning difficulties experienced by SEN students, underscoring the critical value placed on this aspect.

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***Table 1**: Teachers' Perceptions of Knowledge Requirements in Mathematics Instruction*

Item	Not at all important	Less important	Moderately important	Somewhat important	Very important
1. It is important to have strong knowledge in mathematics.	0 (0)	0 (0)	0 (0)	10 (33.3)	20 (66.7)
2. It is important to have general knowledge of how students learn mathematics.	0 (0)	0 (0)	0 (0)	9 (30)	21 (70)
3. It is important to have knowledge about each student individually.	0 (0)	0 (0)	0 (0)	9 (30)	21 (70)
4. It is important to know the specific challenges students face in mathematics.	0 (0)	0 (0)	0 (0)	0 (0)	30 (100)
5. It is important to have teaching experience.	0 (0)	1 (3.0)	2 (6.7)	13 (43.3)	14 (46.7)
6. It is important to have experience teaching mathematics.	0 (0)	0 (0)	5 (16.7)	13 (43.3)	12 (40)
7. It is important to have experience teaching SEN students.	0 (0)	0 (0)	3 (10)	9 (30)	18 (60)

Note: Values are presented in frequency and percentage (in parentheses).

Regarding general teaching experience (item five), the data revealed some variation. Nearly half of the respondents (14 teachers, 46.7%) rated it as very important, followed by 13 teachers (43.3%) who selected somewhat important. However, a small number of respondents viewed it as only moderately important (2 teachers, 6.7%) or less important (1 teacher, 3.3%). This suggests that although general teaching experience is considered highly valuable by most teachers, a small proportion holds a differing view. In terms of specific experience in teaching mathematics (item six), significant variation was again observed, 12 teachers (40%) rated it as very important, 13 teachers (43.3%) as somewhat important and 5 teachers (16.7%) as moderately important. These differences indicate divergent views among teachers regarding the necessity of having specific experience in teaching mathematics, suggesting a need for additional professional development in mathematics pedagogy for certain teachers.

Lastly, with respect to experience specifically in teaching SEN students (item seven), the majority of respondents viewed this aspect as very important (18 teachers, 60%), followed by those who rated it as somewhat important (9 teachers, 30%) and moderately important (3 teachers, 10%). This clearly indicates that teachers consider specialized experience in teaching SEN students to be a critical factor in developing effective pedagogical skills and addressing the unique needs of this learner group. In sum, the findings of this study highlight that teachers generally demonstrate a highly positive perception toward the necessity of possessing strong knowledge and experience in teaching mathematics to SEN students. However, the variation observed in teachers' specific experiences in teaching mathematics underscores the need for more structured and systematic professional training in specialized mathematics pedagogy. Such efforts are essential to ensure that all teachers are equipped to meet the specific challenges faced by SEN students in a comprehensive and effective manner.

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Teachers' Level of Knowledge and Experience in Mathematics Instruction for SEN Students with Learning Disabilities

***Table 2**: Teachers' Level of Knowledge and Experience in Mathematics Instruction*

Item	Strongly disagree	Disagree	Slightly disagree	Slightly agree	Agree	Strogly agree
1. I have strong knowledge in mathematics.	0 (0)	1 (3.3)	6 (20)	3 (10)	17 (56)	3 (10)
2. I have general knowledge about how SEN students learn mathematics.	0 (0)	0 (0)	6 (20)	8 (26.7)	12 (40)	4 (13.3)
3. I have knowledge about each student individually.	0 (0)	0 (0)	4 (13.3)	4 (13.3)	19 (63.3)	3 (10)
4. I am aware of specific challenges faced by SEN students.	0 (0)	0 (0)	4 (13.3)	0 (0)	20 (66.7)	6 (20)
5. I have teaching experience.	0 (0)	0 (0)	3 (10)	0 (0)	19 (63.3)	8 (26.7)
6. I have experience teaching mathematics.	0 (0)	3 (10)	4 (13.3)	3 (10)	15 (50)	5 (16.7)
7. I have experience teaching SEN students.	0 (0)	1 (3.3)	0 (0)	0 (0)	15 (50)	14 (46.7)

Note: Values are presented in frequency and percentage (in parentheses).

This section presents the analysis of the actual level of teachers' knowledge and experience in teaching mathematics to students with SEN who have learning disabilities based on Table 2 above. The data were obtained through self-assessments using a six-point Likert scale (strongly disagree, disagree, slightly disagree, slightly agree, agree, and strongly agree). Overall, the findings indicate that the level of knowledge and experience among teachers in teaching mathematics to SEN students is generally high with a mean score of 4.79 and a standard deviation of 0.95. This standard deviation suggests a moderate level of variation in teachers' knowledge and experience, reflecting differences in their confidence across specific measured aspects.

In detail, the first item, "I have strong knowledge in mathematics," shows that the majority of respondents, 17 teachers, (56%) selected 'agree,' followed by 6 teachers (20%) who chose 'slightly disagree.' Additionally, 3 teachers (10%) selected 'slightly agree' and another 3 (10%) selected 'strongly agree,' while one respondent (3.3%) selected 'disagree.' This distribution reflects that while most teachers are confident in their mathematical content knowledge, a minority still require support in strengthening this area. The second item, "I have general knowledge of how students learn mathematics," shows that 12 respondents (40%) selected 'agree,' while 8 (26.7%) selected 'slightly agree.' Six respondents (20%) selected 'slightly disagree' and 4 respondents (13.3%) selected 'strongly agree.' These results suggest that although a substantial proportion of teachers expressed moderate confidence in their general knowledge of how SEN students learn mathematics, there remains a portion who are less certain, indicating the need for more in-depth training in this area.

For the third item, "I have knowledge about each student individually," the majority of respondents, 19 teachers (63.3%) agreed, while 4 teachers (13.3%) each selected 'slightly agree' and 'slightly disagree.' Only 3 respondents (10%) selected 'strongly agree.' This finding indicates that most teachers acknowledge the importance of understanding students individually; however,

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a minority are not entirely confident in their knowledge of individual SEN learners under their care. The fourth item, "I am aware of the specific challenges students face in learning mathematics," revealed that a large majority of 20 respondents (66.7%) selected 'agree,' followed by 6 respondents (20%) who selected 'strongly agree.' However, 4 respondents (13.3%) selected 'slightly disagree,' indicating a minority who are less certain about the specific challenges faced by SEN students in mathematics learning. This underscores the importance of increasing teacher awareness in this area. For item five, "I have teaching experience," 19 respondents (63.3%) selected 'agree,' while 8 respondents (26.7%) selected 'strongly agree.' Only 3 respondents (10%) selected 'slightly disagree.' This suggests that most teachers in this study possess sufficient and extensive general teaching experience, which serves as a strong foundation in addressing the challenges of teaching SEN students. In the context of specific experience in teaching mathematics (item six), 15 respondents (50%) selected 'agree,' and 5 respondents (16.7%) selected 'strongly agree.' However, the findings also reveal notable variation, as 4 respondents (13.3%) selected 'slightly disagree,' 3 respondents (10%) chose 'slightly agree,' 2 respondents (6.7%) selected 'disagree,' and 1 respondent (3.3%) selected 'strongly disagree.' This variation illustrates the need for more in-depth training in mathematics pedagogy for those teachers who still require reinforcement in this specific teaching experience.

Lastly, the seventh item, "I have experience teaching SEN students," shows that half of the respondents (15 teachers, 50%) selected 'agree,' followed closely by 14 teachers (46.7%) who selected 'strongly agree.' Only one respondent (3.3%) selected 'disagree.' These findings demonstrate that most teachers have substantial direct experience in teaching SEN students, although a small minority may require further exposure and additional training to enhance their confidence and experience in this context. In conclusion, the study findings reveal that teachers' overall levels of knowledge and experience in teaching SEN students are moderately high. However, certain areas still require improvement, particularly in mathematical content knowledge and experience in teaching mathematics specifically. Therefore, more targeted and structured professional training programmes are essential to ensure that all teachers attain a consistent and balanced level of competency in delivering mathematics instruction to students with special educational needs.

DISCUSSIONS, RECOMMENDATIONS AND CONCLUSIONS

This section offers an in-depth interpretation of the study's findings by systematically connecting them with relevant theories and previous empirical studies. The current research provides a preliminary insight into the level of knowledge and experience among SEIP teachers in teaching mathematics to students with SEN with learning disabilities. The findings indicate that teachers hold highly positive perceptions regarding the importance of pedagogical knowledge in mathematics instruction. Specifically, they rated awareness of the challenges faced by SEN students, mastery of mathematical content and understanding of individual learning styles as the most important areas requiring attention. This reflects a high level of professional awareness among teachers concerning the pedagogical demands of inclusive classroom environments. This is consistent with the findings of Lee and Tahar (2023), who emphasized that SEIP teachers must possess both emotional intelligence and pedagogical balance in addressing the complexities of special education.

Nevertheless, the study also reveals a significant gap between teachers' perceptions of mathematics instruction and their actual levels of knowledge and experience. Some teachers admitted a lack of confidence in their mathematical content knowledge, particularly when teaching

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students with learning disabilities. This suggests that although teachers are aware of the need for specialized pedagogy, they may not yet be fully prepared to apply mathematical content effectively in practice. This aligns with the findings of Sabaruddin et al. (2020), who asserted that teaching mathematics to students with special needs requires flexibility in instructional strategies, the use of appropriate teaching aids and a supportive learning environment. Similarly, Hussin et al. (2020) highlighted infrastructural limitations and the lack of specialized training as persistent barriers to effective teaching of SEN students. Comparisons with earlier studies further reinforce the necessity for targeted professional development. Abu Bakar and Tahar (2019) found that while teachers demonstrated strong knowledge of assessment processes for SEN students, their practical skills remained moderate, particularly in designing instructional tools and adopting focused teaching strategies. This implies that experience alone in special education does not automatically translate into effective mathematics instruction unless it is supported by specialized training in areas such as the use of mathematical manipulatives, problem-solving techniques and student-centered learning approaches.

From a theoretical perspective, the findings support key principles of constructivist theory as developed by Piaget and Vygotsky. Both scholars emphasized that learning occurs when students construct meaning through concrete experiences and social interaction. SEN students with learning disabilities, in particular, require structured guidance through approaches such as the ZPD to help them grasp abstract mathematical concepts (Vygotsky, 1978). In this context, the current study reveals that teachers are aware of the importance of experiential learning but lack systematic strategies for implementing it effectively. Furthermore, Shulman's (1987) PCK Model provides another important theoretical foundation supporting these findings. The model asserts that effective teaching occurs when educators possess mastery of both subject content and appropriate instructional methods. This study demonstrates that many SEIP teachers still require reinforcement in mathematical content knowledge, particularly when teaching students who need differentiated instructional approaches.The findings have several important implications for the professional development of special education teachers. Chief among these is the need to implement more systematic and targeted training in specialized mathematics pedagogy. Such training should include the use of concrete manipulatives, problem-solving strategies, play-based learning approaches and assistive technologies tailored to the cognitive levels of SEN students. Khalil and Hantira (2022) emphasized that effective use of assistive technologies depends on teachers' knowledge and positive attitudes, which can only be cultivated through sustained and focused training. In this regard, the present study supports efforts to expand the scope of current training programs to comprehensively address these dimensions. These efforts also align with the aspirations outlined in the PPPM 2013–2025 and SDG 4, both of which stress the importance of continuous professional development and ensuring equitable access to quality education for all learners.

However, this study is not without its limitations. It was conducted with a relatively small sample, involving only 30 SEIP teachers from several schools in Sarawak. This limited sample size may not fully reflect the broader context of special education teachers across Malaysia. Additionally, the use of a quantitative approach through questionnaires may not have captured the emotional dimensions, day-to-day challenges, and classroom dynamics between teachers and SEN students. Therefore, further research employing qualitative methodologies such as in-depth interviews, classroom observations and action research is strongly recommended to gain a more holistic understanding of teachers' lived experiences. Such approaches could also serve to evaluate the effectiveness of current training programs and identify the most effective interventions for enhancing mathematics teaching competencies for SEN students.

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Conclusions

This study has provided a comprehensive overview of the knowledge and experience levels among SEIP teachers in Sarawak in teaching mathematics to students with SEN students with learning difficulties. The findings revealed that, in general, teachers possess a high level of pedagogical knowledge in special education and demonstrate a commendable awareness of the importance of understanding students' learning styles and individual needs. However, their awareness and confidence in teaching mathematics to MBPK remain insufficient, particularly in addressing the specific challenges of mathematics learning and in implementing targeted instructional strategies. This highlights a gap between teachers' general experience in special education and their actual competency in effectively delivering mathematics instruction. Broad teaching experience alone does not guarantee proficiency in special mathematics pedagogy, especially when teachers lack systematic, structured professional training tailored to the real demands of the classroom. Therefore, this study underscores the urgent need to enhance professional development programs that focus specifically on mathematics pedagogy for special education, incorporating concrete approaches, the use of appropriate teaching aids and student-centred instructional strategies. The implications of this study are particularly significant for stakeholders such as the Ministry of Education Malaysia, teacher training institutions and school administrators, who must plan and implement more targeted and comprehensive training initiatives. This aligns with the aspirations of the PPPM 2013–2025 and SDG 4 which emphasize inclusive, equitable, and quality education for all learners. With strengthened training and professional support, it is hoped that PPKI teachers across Malaysia, particularly in regions such as Sarawak, will be better equipped to deliver more effective and meaningful mathematics instruction to SEN students, thereby contributing to the overall improvement of special education quality nationwide.

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