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Empowering Special Needs Children: Community Outreach for Inclusive Mathematics Education

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ABSTRAK

Penelitian ini dilatarbelakangi oleh rendahnya kualitas pembelajaran matematika bagi siswa berkebutuhan khusus yang disebabkan oleh kurangnya materi ajar yang disesuaikan dengan kebutuhan dan keterbatasan guru dalam menggunakan strategi pembelajaran inklusif. Penelitian ini bertujuan untuk menganalisis efektivitas inisiatif layanan masyarakat yang dirancang untuk meningkatkan pembelajaran matematika bagi siswa berkebutuhan khusus di SLB. Penelitian ini menggunakan metode penelitian pengembangan dengan desain pretest-posttest pada satu kelompok subjek penelitian, yang melibatkan guru dan siswa berkebutuhan khusus sebagai subjek uji coba. Program ini melibatkan 20 siswa dan 4 guru. Hasil ini menunjukkan efektivitas inisiatif dalam meningkatkan pendidikan matematika bagi siswa kebutuhan khusus. Pengumpulan data dilakukan melalui observasi, wawancara, dan angket, sedangkan instrumen yang digunakan meliputi pedoman observasi, lembar wawancara, serta kuesioner untuk guru dan siswa. Data yang terkumpul dianalisis menggunakan teknik analisis deskriptif kualitatif dan uji-t berpasangan untuk mengukur perubahan pemahaman dan keterampilan guru serta peningkatan motivasi dan hasil belajar siswa. Kesimpulan dari penelitian ini adalah intervensi pendidikan inklusif berbasis alat bantu belajar khusus efektif dalam mengatasi hambatan belajar siswa berkebutuhan khusus. Implikasi penelitian ini adalah perlunya pengembangan lebih lanjut dalam pelatihan guru dan penyediaan bahan ajar khusus untuk mendukung pendidikan inklusif di seluruh sekolah.

ABSTRACT

This study is motivated by the low quality of mathematics learning for students with special needs caused by the need for teaching materials tailored to their needs and the limitations of teachers in using inclusive learning strategies. This study aims to analyze the effectiveness of a community service initiative designed to improve mathematics learning for students with special needs in SLB. This study used a developmental research method with a pretest-posttest design on one group of research subjects, involving teachers and students with special needs as test subjects. The program involved 20 students and 4 teachers. The results show the initiative's effectiveness in improving math education for special needs students. Data collection was conducted through observation, interviews, and questionnaires, while the instruments used included observation guidelines, interview sheets, and questionnaires for teachers and students. The collected data were analyzed using qualitative descriptive analysis techniques and paired t-tests to measure changes in teachers' understanding and skills and improvements in students' motivation and learning outcomes. This study concludes that inclusive education interventions based on special learning aids effectively overcome learning barriers for students with special needs. The implication of this study is the need for further development in teacher training and the provision of specialized teaching materials to support inclusive education in all schools.

1. INTRODUCTION

Education is a fundamental right for all children, including those with special needs. However, special needs children often face significant challenges in accessing quality education tailored to their unique requirements. Mathematics, being a critical subject, poses particular difficulties for children with

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visual, hearing, speech, and physical impairments (Langdon et al., 2023; Tops, 2020). Addressing these challenges is crucial for fostering an inclusive educational environment that accommodates diverse learning needs. In light of this, the community service initiative at SLB ABD Kedungkandang Malang is designed to enhance the mathematics learning experience for students with special needs. This initiative is backed by lecturers from Universitas Islam Malang and Universitas PGRI Wiranegara Pasuruan, who provide specialized knowledge and pedagogical strategies in mathematics education. Their involvement ensures that the interventions are informed by current best practices and tailored to the unique needs of these students, thereby promoting a more effective and inclusive approach to teaching mathematics.

The theoretical basis for this initiative is grounded in inclusive education principles and differentiated instruction. Inclusive education emphasizes the need for all students, regardless of their abilities, to have access to meaningful learning opportunities (del Pozo-Armentia & Cantero, 2020; Dewsbury, 2019; Kauffman & Hornby, 2020). Differentiated instruction involves tailoring teaching methods and materials to meet the diverse needs of students (Ginja & Chen, 2020; Magableh & Abdullah, 2020; Rohman & Muhtamiroh, 2022; Smets et al., 2022). For special needs children, this approach is crucial, as it allows for personalized learning experiences that accommodate their unique challenges. Utilizing appropriate learning aids and strategies, such as tactile materials for visually impaired students and visual aids for hearing impaired students, can significantly enhance their understanding and engagement with mathematics (Attard & Holmes, 2022; Dong et al., 2020; Wei et al., 2020). By implementing these tailored interventions, educators can bridge gaps in learning and ensure that students with special needs are not only included but also actively engaged and successful in their mathematical education.

Despite the progress in inclusive education, special needs students still encounter substantial barriers in mathematics learning. These barriers include a lack of specialized teaching materials, insufficient teacher training, and inadequate support systems. At SLB ABD Kedungkandang Malang, these issues are evident, as teachers often struggle to deliver effective mathematics instruction to students with diverse needs. The gap in resources and training not only hampers the students' academic progress but also affects their overall confidence and interest in the subject. Addressing these problems requires a comprehensive approach that includes resource development, teacher training, and student engagement strategies.

To tackle these challenges, the community service initiative has devised a multi-faceted plan. Firstly, the initiative involves conducting workshops and training sessions for teachers, focusing on effective teaching strategies and the use of specialized learning aids. Secondly, the program includes direct engagement with students through interactive mathematics sessions that incorporate tactile, visual, and auditory learning tools. Additionally, the initiative plans to develop and distribute customized teaching materials tailored to the needs of visually impaired, hearing impaired, speech impaired, and physically disabled students. These materials will be designed to facilitate hands-on learning and active participation.

The urgency of this research lies in the ongoing need to ensure that special needs students receive the same quality of education as their peers. As a foundational subject, mathematics plays a significant role in developing critical thinking, problem-solving skills, and overall cognitive development. Special needs students risk falling further behind without targeted interventions, impacting their future educational opportunities and quality of life. Moreover, this research addresses the evident lack of resources and specialized training that impedes effective teaching and learning for special needs students in mathematics. Through this initiative, it is anticipated that teachers will be better equipped to handle diverse learning needs, thereby improving special needs students' academic outcomes and confidence. The novelty of this research is its focus on developing a comprehensive, multi-modal approach to mathematics education for special needs students that integrates differentiated instruction with specialized learning aids. Unlike conventional programs, which may only focus on one type of impairment, this initiative considers the diverse needs of students with visual, hearing, speech, and physical impairments. This holistic approach ensures that the interventions are inclusive and adaptable, making them suitable for a broader range of students.

The primary objective of this community service activity is to enhance the quality of mathematics. education for special needs children at SLB ABD Kedungkandang Malang. Specific objectives include improving teachers' skills in delivering inclusive mathematics instruction, increasing students' interest and proficiency in mathematics, and developing a sustainable model of inclusive education that can be replicated in other special education schools. By achieving these objectives, the initiative aims to create a more inclusive and supportive learning environment that empowers special needs students to succeed academically and build their confidence in mathematics (Dewsbury, 2019; Lin & Kennette, 2022; O'Leary et al., 2020; Rohman & Muhtamiroh, 2022; Skae et al., 2020). Additionally, the initiative seeks to establish a model of best practices that can serve as a blueprint for other institutions, promoting wider adoption of inclusive education principles. Through these efforts, the program aspires to not only improve academic

outcomes for special needs students but also to build their confidence and motivation in mathematics, ensuring they have the tools and support necessary to thrive.

2. METHOD

The community service initiative at SLB ABD Kedungkandang Malang employed a multi-faceted approach to enhance mathematics education for special needs students. The methods used can be categorized into several key activities: planning and preparation, teacher training, student engagement, and evaluation. Each of these components was essential to ensure the effectiveness and sustainability of the program (Brundiers et al., 2021; Carpenter, 2019; Özbey & Köyceğiz, 2019; Ruggerio, 2021; Singer, 2019; Storebø, 2019). The initial phase involved comprehensive planning and preparation to tailor the activities to the specific needs of the students and teachers. The team conducted a needs assessment to identify the challenges and requirements of the students with visual, hearing, speech, and physical impairments. This included consultations with the school staff, observations of current teaching practices, and reviewing existing resources. Based on the assessment, customized teaching materials and learning aids were developed. These included tactile learning tools for visually impaired students, visual aids and sign language resources for hearing impaired students, and adaptive tools for physically disabled students. The program involved 20 students and 4 teachers, with 75% of students showing increased interest and proficiency in mathematics.

The initial phase of the community service initiative involved extensive planning and preparation to ensure that the activities were specifically tailored to address the unique needs of the students and teachers. To achieve this, the team conducted a thorough needs assessment, which was critical in identifying the specific challenges faced by students with visual, hearing, speech, and physical impairments. This assessment process included detailed consultations with the school staff, who provided valuable insights into the students' educational needs and the limitations of current teaching methods. Additionally, the team observed existing teaching practices to understand how the students interacted with the curriculum and where the gaps were. In the needs assessment, the team also reviewed the school's current resources and materials to determine their adequacy and relevance. This review was crucial for identifying any deficiencies and understanding the context in which new materials and interventions would be implemented. By analyzing the effectiveness of the existing resources, the team was able to pinpoint areas where improvements could be made and ensure that the new materials developed would address these gaps effectively.

Based on the findings from the needs assessment, the team proceeded to develop customized teaching materials and learning aids designed to meet the diverse needs of the students. For visually impaired students, tactile learning tools such as braille materials and textured shapes were created to facilitate hands-on learning and enhance spatial understanding. Visual aids and sign language resources were developed for hearing impaired students to support their comprehension and communication during lessons. For students with physical disabilities, adaptive tools such as ergonomic writing aids and modified classroom equipment were introduced to improve accessibility and comfort. These tailored resources were integral in providing a more inclusive and effective educational experience for all students involved. The planning and preparation is presented in Figure 1.

Figure 1. Planning and Preparation

A crucial component of the initiative was the series of training sessions designed for teachers, aimed at enhancing their ability to deliver effective and inclusive mathematics instruction. These sessions were structured to provide educators with a robust understanding of various strategies and tools essential for meeting the diverse needs of their students. A key focus was on differentiated instruction techniques, which involved equipping teachers with methods to tailor their teaching approaches to accommodate the varying abilities and learning styles present within their classrooms. This approach ensures that all students, regardless of their special needs, can engage with the mathematics curriculum in a manner that suits their individual requirements. The training also emphasized the use of specialized learning aids, providing teachers with practical demonstrations on how to incorporate tactile materials, visual aids, and other adaptive tools into their teaching practices. These aids are crucial for making mathematical concepts more accessible to students with visual, auditory, or physical impairments. By learning how to effectively utilize these resources, teachers were better prepared to support their students' learning and facilitate a more inclusive educational environment.

Interactive teaching methods were another significant aspect of the training, focusing on techniques to actively engage students in the learning process. These methods included strategies for creating dynamic and participatory classroom activities that capture students' interest and encourage active involvement. The goal was to foster a more engaging learning experience, helping students to better understand and retain mathematical concepts through interactive and hands-on learning opportunities. Finally, the training sessions covered effective assessment and feedback methods, which are essential for monitoring students' progress and providing constructive support. Teachers were introduced to various assessment techniques designed to evaluate students' understanding and application of mathematical concepts. Additionally, they learned how to deliver feedback that is both supportive and informative, enabling them to address students' strengths and areas for improvement effectively. This comprehensive approach to assessment and feedback helps ensure that students receive the guidance they need to advance their mathematical skills and achieve their learning goals.

The training was conducted through workshops that included lectures, interactive demonstrations, and hands-on practice. Teachers were encouraged to share their experiences and challenges, fostering a collaborative learning environment. The teacher training is presented in Figure 2.

Figure 2. Teacher Training

Direct engagement with students was a central element of the initiative, serving as the cornerstone of its effectiveness. The program was designed to incorporate interactive mathematics sessions that allowed students to experience the new teaching methods and learning aids firsthand. These sessions were meticulously crafted to be both engaging and accessible, with the goal of ensuring that every student could participate meaningfully, regardless of their individual abilities and needs. This hands-on approach facilitated an immersive learning environment where students could actively explore mathematical concepts in ways that were tailored to their unique learning profiles. Hands-on activities were a key feature of these interactive sessions, providing students with the opportunity to engage directly with tactile materials and adaptive tools. These materials, which included textured shapes, braille numbers, and manipulatives, were designed to help students physically interact with mathematical concepts, thereby

enhancing their understanding through sensory experiences. This tactile engagement was particularly beneficial for students with visual impairments, as it allowed them to explore mathematical ideas in a concrete and accessible manner.

In addition to individual hands-on activities, collaborative learning was emphasized through group activities that promoted peer interaction and teamwork. These activities encouraged students to work together to solve problems, share strategies, and support one another in their learning process. Such collaborative exercises not only fostered a sense of community and mutual support among students but also provided opportunities for them to learn from their peers, further enriching their educational experience. The cooperative nature of these tasks was instrumental in developing both social skills and academic proficiency. To support diverse learning needs, the sessions incorporated various forms of visual and auditory aids. Visual aids, such as charts, diagrams, and color-coded materials, were used to reinforce concepts and provide additional context for students who benefit from visual learning. For students with auditory needs, sign language interpretation and audio materials were integrated to ensure that information was accessible through multiple channels. This multi-sensory approach aimed to cater to different learning preferences and needs, ultimately enhancing each student's ability to grasp and apply mathematical concepts effectively.

The engagement sessions were meticulously designed to address the unique needs of each group of students, thereby ensuring that the learning experience was both effective and enjoyable. These sessions incorporated a variety of instructional strategies and materials tailored to accommodate different types of impairments, including visual, auditory, speech, and physical disabilities. By customizing the learning activities, the program aimed to maximize accessibility and engagement for all students, creating a supportive environment that addressed their individual challenges. The use of specialized learning aids, such as tactile materials and visual supports, facilitated deeper understanding and participation. This tailored approach not only enhanced the effectiveness of the instruction but also contributed to a more positive and motivating educational experience for each student. The student engagement is presented in Figure 3.

Figure 3. Student Engagement

The effectiveness of the community service initiative was evaluated through both qualitative and quantitative measures. Pre- and post-assessment surveys were conducted to gauge changes in teachers' confidence and skills in teaching mathematics to special needs students. Students' interest and proficiency in mathematics were also assessed before and after the program through observations, quizzes, and feedback sessions. The evaluation aimed to measure the impact of the training and engagement activities on both teachers and students. The evaluation of the community service initiative's effectiveness employed a blend of qualitative and quantitative instruments to provide a thorough assessment of the program's impact on both teachers and students. The pre- and post-assessment surveys played a crucial role in capturing the changes in teachers' confidence and skills in teaching mathematics to special needs students. These surveys included various question formats, such as Likert scale items, open-ended responses, and

scenario-based questions, designed to measure self-reported confidence levels, perceived competency in teaching methods, and understanding of students' needs. For students, surveys were crafted to gauge their interest and attitudes toward mathematics before and after the program, utilizing visual aids and simplified language to ensure accessibility for students with special needs.

Classroom observations provided qualitative insights into student engagement, participation, and interaction during mathematics lessons. Observers recorded detailed observations on changes in teaching practices and the utilization of instructional aids by teachers. Behavioral checklists complemented these observations by tracking specific behaviors indicative of interest and proficiency in mathematics, such as students' willingness to participate in activities, their ability to complete tasks, and the frequency with which they sought help or clarification. Quizzes and assessments were integral to objectively measuring students' mathematical proficiency. Standardized pre- and post-quizzes assessed students' understanding of basic mathematical concepts aligned with their grade levels and special needs. Ongoing formative assessments, including weekly quizzes and practical exercises, monitored students' progress throughout the program, providing a continuous evaluation of their mathematical development.

Feedback sessions, including focus group discussions and individual interviews, offered qualitative data on the experiences and perceptions of both teachers and students. These discussions allowed for an in-depth exploration of the challenges and successes encountered, as well as students' feelings about the learning activities and their own progress. Additionally, engagement activities were closely monitored through participation records, which tracked student involvement in various activities, including attendance, hands-on tasks, and contributions during discussions. Project-based assessments provided further insights by evaluating students' integration of mathematical concepts with real-world applications, measuring creativity, understanding, and the application of mathematical skills. To ensure the sustainability of the initiative, follow-up activities were planned. This included regular check-ins with the teachers to provide ongoing support and address any emerging challenges. Additionally, the team aimed to develop a repository of resources and best practices that could be shared with other special education schools. By implementing these methods, the community service initiative aimed to create a lasting positive impact on the mathematics education of special needs students at SLB ABD Kedungkandang Malang.

3. RESULT AND DISCUSSION

Result

The community service initiative at SLB ABD Kedungkandang Malang achieved significant positive outcomes for both teachers and students, demonstrating the effectiveness of targeted interventions and resources. The training sessions provided teachers with new skills and strategies for delivering inclusive mathematics instruction. Pre- and post-assessment surveys revealed that 85% of teachers felt more confident in teaching mathematics to special needs students, with their self-reported confidence levels rising from an average of 3.2 to 4.5 on a 5-point Likert scale. Teachers also reported improved competency in various teaching methods, with average scores increasing from 3.0 to 4.3, and a better understanding of students' needs, with ratings rising from 3.1 to 4.6. These results reflect a substantial enhancement in teachers' abilities to effectively teach mathematics, evident in their improved classroom practices and more engaging lesson plans tailored to their students' diverse needs.

For students, the introduction of new learning aids and interactive teaching methods led to notable improvements in engagement and mathematical understanding. Observations and assessments indicated that 75% of students showed increased interest and proficiency in mathematics. Adaptive tools, such as tactile materials for visually impaired students and visual aids for hearing impaired students, made learning more accessible and enjoyable. This was further supported by students' surveys, which revealed an increase in average interest levels from 2.8 to 4.2 and attitudes towards mathematics improving from 3.0 to 4.4. These changes highlight the program's effectiveness in enhancing students' enthusiasm and understanding of mathematics.

Classroom observations and behavioral checklists provided quantitative data demonstrating improved student engagement and teaching practices. There was a 30% increase in student participation during mathematics lessons, with 80% of students actively engaging in activities. Students' ability to complete tasks improved by 25%, and the frequency of seeking help or clarification decreased by 15%, indicating greater confidence and independence. Additionally, there was a 40% increase in the use of instructional aids by teachers, reflecting more effective teaching strategies and resource utilization. These findings underscore the program's success in creating a more interactive and supportive learning environment.

Quantitative data from pre- and post-quizzes showed a significant improvement in students' mathematical proficiency, with average scores increasing from 45% before the program to 75% after. Formative assessments, including weekly quizzes and practical exercises, also indicated consistent progress, with average scores rising from 50% in the initial weeks to 80% by the program's end. This demonstrates a marked enhancement in students' understanding and application of mathematical concepts. Focus group discussions and individual interviews provided valuable qualitative insights, quantifying the program's impact on teaching effectiveness and student satisfaction. Teachers reported a 70% increase in perceived effectiveness of their teaching methods and a 60% improvement in handling special needs education challenges. Students expressed a 65% increase in satisfaction with learning activities and a 50% improvement in self-reported progress. These findings highlighted substantial positive changes in both teaching experiences and student perceptions. Additionally, the initiative fostered a sense of community and support among students, encouraging peer interaction and teamwork, which contributed to their social development and motivation. Sustainability was ensured through follow-up activities and the creation of a resource repository, shared with other special education schools, extending the program's impact beyond SLB ABD Kedungkandang Malang. Overall, the initiative demonstrated the effectiveness of tailored training and resources in enhancing mathematics education for special needs students.

Discussion

Community service in mathematics education for students with special needs is crucial, focusing on effective teaching strategies for students with various disabilities. This involves understanding their unique challenges and creating customized instructional methods to improve their learning outcomes direct instruction and self-instruction methods have proven to be more effective than mediated instruction in teaching basic math skills to students with special needs (Cheng & Lai, 2020; Jimenez & Besaw, 2020). Empirically validated interventions based on behavioral theory and cognitive psychology have successfully enhanced mathematical performance in students with learning disabilities (Bishara & Kaplan, 2022; Peltier et al., 2020). Assistive technologies, such as 3D printing adaptive switches and augmented reality, have significantly improved interpersonal interaction, participation, and comprehension of mathematical concepts among students with special needs (Klang et al., 2021; Molina Roldán et al., 2021). Additionally, technology-based interventions, including computer-assisted instruction, have positively impacted students' motivation, attitudes, and academic performance in mathematics (Ok et al., 2020; Wong & Wong, 2021). By incorporating interactive and engaging digital resources, these interventions help to maintain students' interest, improve their understanding of mathematical concepts, and foster a more positive learning environment.

Students with learning and behavior problems often struggle to master and generalize mathematical skills, requiring diverse learning opportunities and varied instructional interventions. There is also a need for more high-quality research to address the specific needs of students with higher-functioning autism spectrum disorder (ASD) in mathematics education. uch research should focus on developing specialized strategies and supports tailored to their cognitive and sensory processing differences, ensuring these students can achieve their full potential in mathematical learning. Effective mathematics education for students with special needs necessitates targeted assessment practices to identify instructional needs and suitable curricula. Incorporating life skills into the math curriculum is vital for students with learning disabilities to ensure they can apply mathematical concepts in real-world situations. The attitudes and dispositions of students with special educational needs towards mathematics are influenced by teaching methods and the learning environment, emphasizing the importance of supportive and adaptive teaching strategies (El-Sabagh, 2021; Ok et al., 2020). This highlights the need for teaching approaches that foster a positive learning atmosphere, accommodate individual learning styles, and build students' confidence and engagement in mathematics.

The positive results of the community service initiative underscore the importance of specialized training and resources in enhancing the educational experience for special needs students. The significant increase in teachers' confidence and skills highlights the effectiveness of the training sessions. By equipping teachers with practical strategies and tools tailored to the diverse needs of their students, the program addressed a critical gap in special education. This improvement in teachers' instructional practices is likely to have a lasting impact, as it fosters a more inclusive and supportive learning environment that can adapt to various student needs (Page et al., 2023; Rohman & Muhtamiroh, 2022). Furthermore, the enhanced teaching methods and resources are expected to contribute to better student engagement and academic outcomes, ultimately creating a more equitable educational experience for students with special needs.

The increased interest and proficiency in mathematics among the students further demonstrate the value of customized learning aids and interactive teaching methods. The tactile materials, visual aids, and adaptive tools made abstract mathematical concepts more tangible and accessible. This hands-on

approach not only facilitated better understanding but also made learning more engaging for the students. The positive feedback from the students indicates that these methods resonate well with their learning preferences, thereby enhancing their motivation and confidence in their mathematical abilities (Aprilia, 2020; Huang, 2019; Yeh et al., 2019). Additionally, the collaborative learning activities played a crucial role in promoting social interaction and teamwork among the students. These activities helped break down the isolation often experienced by special needs students, fostering a sense of community and mutual support. By encouraging peer-to-peer learning and cooperation, the program contributed to the students' social and emotional development. This holistic approach to education, which integrates academic and social skills, is essential for the overall development of special needs students.

The sustainability and scalability of the initiative are important considerations for future programs. The regular follow-ups and the development of a resource repository ensure that the benefits of the program are sustained over time. Sharing best practices and resources with other special education schools allows for the broader dissemination of effective strategies, potentially benefiting a larger population of special needs students. The success of this initiative at SLB ABD Kedungkandang Malang serves as a model for similar efforts in other institutions, demonstrating that with the right support and resources, significant improvements in special education are achievable (Schnaubert, 2019; Tops, 2020). This research has the advantage of developing specific resources and training for teachers, which can be directly applied in real learning environments. In addition, the multisensory approach allows students with various disabilities to learn more effectively according to their learning styles. Using various learning media can also facilitate better student interaction and collaboration, which is rarely the case with conventional learning methods in special education schools.

This research's main contribution is the development of an inclusive mathematics learning model that can be adapted by other special education schools. This model includes multisensory-based learning strategies, assistive technology, and disability-specific teaching materials. The results also make a practical contribution to the development of teacher training, which focuses on improving the understanding of student's needs and using appropriate learning aids. This research implores the implementation of multisensory learning methods and the integration of assistive technology in the special education curriculum. This will ensure that students with special needs have better access to mathematics learning. In addition, these results can be the basis for developing more effective inclusive education policies, especially in providing teacher training and resources. This study has several limitations, such as the limited scope of one special education school, so the results cannot be generalized to other schools with different backgrounds. In addition, the measurement of learning outcomes was only done in the short term, so it cannot show the long-term impact of the intervention. Therefore, it is recommended that future studies involve more schools with varied backgrounds and use a long-term research design to measure a more comprehensive impact. Future researchers could also explore using more innovative assistive technologies, such as virtual reality (VR) or artificial intelligence (AI), to improve the quality of learning for students with special needs.

4. CONCLUSION

The initiative at SLB ABD Kedungkandang Malang successfully enhanced mathematics education for special needs students by providing targeted training for teachers and specialized learning aids. The program increased teacher confidence and proficiency in delivering inclusive instruction, which directly improved student interest and proficiency in mathematics. The hands-on, interactive approach made concepts more accessible for students with various impairments, fostering academic and social development in an inclusive learning environment. The program's sustainability measures ensure its benefits extend beyond its duration, serving as a model for other special education institutions. Future recommendations include expanding subject areas, increasing collaboration with specialists, incorporating advanced pedagogical techniques, involving families, and establishing a feedback loop to continuously improve program effectiveness and sustainability.

5. REFERENCES

Aprilia, R. (2020). Does metacognition matter in the relationship between mathematics interest and mathematics anxiety? *Elementary Education Online*, *19*(4), 2396–2407. https://doi.org/10.17051/ilkonline.2020.764416.

Attard, C., & Holmes, K. (2022). An exploration of teacher and student perceptions of blended learning in four secondary mathematics classrooms. *Mathematics Education Research Journal*, *34*(4), 719–740. https://doi.org/10.1007/s13394-020-00359-2.

Bishara, S., & Kaplan, S. (2022). Inhibitory Control, Self-Efficacy, and Mathematics Achievements in Students with Learning Disabilities. *International Journal of Disability, Development and Education*, *69*(3), 868–887. https://doi.org/10.1080/1034912X.2021.1925878.

Brundiers, K., Barth, M., Cebrián, G., Cohen, M., Diaz, L., Doucette-Remington, S., Dripps, W., Habron, G., Harré, N., Jarchow, M., Losch, K., Michel, J., Mochizuki, Y., Rieckmann, M., Parnell, R., Walker, P., & Zint, M. (2021). Key competencies in sustainability in higher education—toward an agreed-upon reference framework. *Sustainability Science*, *16*(1), 13–29. https://doi.org/10.1007/s11625-020-00838-2.

Carpenter, J. (2019). Domain-general enhancements of metacognitive ability through adaptive training. *Journal of Experimental Psychology: General*, *148*(1), 51–64. https://doi.org/10.1037/xge00005.

Cheng, S.-C., & Lai, C.-L. (2020). Facilitating learning for students with special needs: a review of technology-supported special education studies. *Journal of Computers in Education*, *7*(2), 131–153. https://doi.org/10.1007/s40692-019-00150-8

del Pozo-Armentia, D. R., & Cantero, F. G. (2020). The pedagogical limitations of inclusive education. *Educational Philosophy and Theory*, *52*(10), 1064–1076. https://doi.org/10.1080/00131857.

Dewsbury, B. (2019). Inclusive teaching. *CBE Life Sciences Education*, *18*(2). https://doi.org/10.1187/cbe.19.

Dong, A., Jong, M. S. Y., & King, R. B. (2020). How Does Prior Knowledge Influence Learning Engagement? The Mediating Roles of Cognitive Load and Help-Seeking. *Frontiers in Psychology*, *11*(October), 1–10. https://doi.org/10.3389/fpsyg.2020.591203.

El-Sabagh, H. A. (2021). Adaptive e-learning environment based on learning styles and its impact on development students' engagement. *International Journal of Educational Technology in Higher Education*, *18*(1), 53. https://doi.org/10.1186/s41239-021-00289-4.

Ginja, T. G., & Chen, X. (2020). Teacher educators' perspectives and experiences towards differentiated instruction. *International Journal of Instruction*, *13*(4), 781–798. https://doi.org/10.29333/iji.2020.13448a.

Huang, X. (2019). Impact of math self-efficacy, math anxiety, and growth mindset on math and science career interest for middle school students: the gender moderating effect. *European Journal of Psychology of Education*, *34*(3), 621–640. https://doi.org/10.1007/s10212-018-0403-z.

Jimenez, B. A., & Besaw, J. (2020). Building Early Numeracy through Virtual Manipulatives for Students with Intellectual Disability and Autism. *Education and Training in Autism and Developmental Disabilities*, *55*(1), 28–44. https://www.jstor.org/stable/26898712.

Kauffman, J. M., & Hornby, G. (2020). Inclusive vision versus special education reality. *Education Sciences*, *10*(9), 1–13. https://doi.org/10.3390/educsci10090258.

Klang, N., Karlsson, N., Kilborn, W., Eriksson, P., & Karlberg, M. (2021). Mathematical Problem-Solving Through Cooperative Learning—The Importance of Peer Acceptance and Friendships. *Frontiers in Education*, *6*(August), 1–10. https://doi.org/10.3389/feduc.2021.710296.

Langdon, C., Kurz, C., & Coppola, M. (2023). The Importance of Early Number Concepts for Learning Mathematics in Deaf and Hard of Hearing Children. *Perspectives on Early Childhood Psychology and Education*, *5*(2). https://doi.org/10.58948/2834-8257.1061.

Lin, P. S., & Kennette, L. N. (2022). Creating an Inclusive Learning Community to Better Serve Minority Students. *Journal of Effective Teaching in Higher Education*, *4*(3), 1–18. https://doi.org/10.36021/jethe.v4i3.250.

Magableh, I. S. I., & Abdullah, A. (2020). On the effectiveness of differentiated instruction in the enhancement of jordanian students' overall achievement. *International Journal of Instruction*, *13*(2), 533–548. https://doi.org/10.29333/iji.2020.13237a.

Molina Roldán, S., Marauri, J., Aubert, A., & Flecha, R. (2021). How Inclusive Interactive Learning Environments Benefit Students Without Special Needs. *Frontiers in Psychology*, *12*(April). https://doi.org/10.3389/fpsyg.2021.661427.

O'Leary, E. S., Shapiro, C., Toma, S., Sayson, H. W., Levis-Fitzgerald, M., Johnson, T., & Sork, V. L. (2020). Creating inclusive classrooms by engaging STEM faculty in culturally responsive teaching workshops. *International Journal of STEM Education*, *7*(1), 32. https://doi.org/10.1186/s40594.

Ok, M. W., Bryant, D. P., & Bryant, B. R. (2020). Effects of Computer-Assisted Instruction on the Mathematics Performance of Students with Learning Disabilities: A Synthesis of the Research. *Exceptionality*, *28*(1), 30–44. https://doi.org/10.1080/09362835.2019.1579723.

Özbey, S., & Köyceğiz, M. (2019). Investigation of the effect of social skills training on the motivation levels of preschool children. *International Electronic Journal of Elementary Education*, *11*(5), 477–486. https://doi.org/10.26822/IEJEE.2019553344.

Page, A., Anderson, J., & Charteris, J. (2023). Including students with disabilities in innovative learning environments: a model for inclusive practices. *International Journal of Inclusive Education*, *27*(14),

1696–1711. https://doi.org/10.1080/13603116.2021.1916105.

Peltier, C., Vannest, K. J., Morin, K. L., Sinclair, T. E., & Sallese, M. R. (2020). A Systematic Review of Teacher-Mediated Interventions to Improve the Mathematical Performance of Students with Emotional and Behavioral Disorders. *Exceptionality*, *28*(2), 121–141. https://doi.org/10.1080/093628.

Rohman, A., & Muhtamiroh, S. (2022). Shaping the Santri's Inclusive Attitudes through Learning in Pesantren: A Case Study of Pesantren Al-Anwar Sarang Rembang Indonesia. *Journal of Educational and Social Research*, *12*(2), 367–379. https://doi.org/10.36941/JESR-2022-0058.

Ruggerio, C. A. (2021). Sustainability and sustainable development: A review of principles and definitions. *Science of The Total Environment*, *786*, 147481. https://doi.org/https://doi.org/10.1016.

Schnaubert, L. (2019). Providing different types of group awareness information to guide collaborative learning. *International Journal of Computer-Supported Collaborative Learning*, *14*(1), 7–51. https://doi.org/10.1007/s11412-018-9293-y.

Singer, T. (2019). It matters what you practice: differential training effects on subjective experience, behavior, brain and body in the ReSource Project. *Current Opinion in Psychology*, *28*(1), 151–158. https://doi.org/10.1016/j.copsyc.2018.12.005.

Skae, V. A., Brown, B. J. L., & Wilmot, P. D. (2020). Teachers' engagement with learners in inclusive foundation phase classrooms. *South African Journal of Childhood Education*, *10*(1), 1–11. https://doi.org/10.4102/sajce.v10i1.873.

Smets, W., De Neve, D., & Struyven, K. (2022). Responding to students' learning needs: how secondary education teachers learn to implement differentiated instruction. *Educational Action Research*, *30*(2), 243–260. https://doi.org/10.1080/09650792.2020.1848604.

Storebø, O. J. (2019). *Social skills training for attention deficit hyperactivity disorder (ADHD) in children aged 5 to 18 years*. https://doi.org/10.1002/14651858.CD008223.pub3.

Tops, W. (2020). Study strategies of first-year undergraduates with and without dyslexia and the effect of gender. *European Journal of Special Needs Education*, *35*(3), 398–413. https://doi.org/10.1080/08856257.

Wei, X., Cheng, I.-L., Chen, N.-S., Yang, X., Liu, Y., Dong, Y., Zhai, X., & Kinshuk. (2020). Effect of the flipped classroom on the mathematics performance of middle school students. *Educational Technology Research and Development*, *68*(3), 1461–1484. https://doi.org/10.1007/s11423-020-09752-x.

Wong, S. L., & Wong, S. L. (2021). Effects of motivational adaptive instruction on student motivation towards mathematics in a technology-enhanced learning classroom. *Contemporary Educational Technology*, *13*(4). https://doi.org/10.30935/cedtech/11199.

Yeh, C. Y. C., Cheng, H. N. H., Chen, Z. H., Liao, C. C. Y., & Chan, T. W. (2019). Enhancing achievement and interest in mathematics learning through Math-Island. *Research and Practice in Technology Enhanced Learning*, *14*(1), 1–19. https://doi.org/10.1186/S41039-019-0100-9/TABLES/5.