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Enhancing Student Achievement Through Tailored Mathematics Instruction

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ABSTRAK

Transisi pembelajaran dalam jaringan online menjadi pembelajaran tatap muka terbatas, memerlukan inovasi dalam pembelajaran untuk membangkitkan motivasi dan hasil belajar peserta didik. Tujuan penelitian ini yaitu untuk mengembangkan pembelajaran matematika diferensiasi dalam rangka meningkatkan hasil belajar siswa dan untuk mengetahui kualitas pembelajaran matematika diferensiasi. Penelitian ini merupakan penelitian pengembangan menggunakan model ADDIE. Teknik analisis data yang dilakukan dalam penelitian ini adalah untuk tahap analisis digunakan asesmen diagnostik, sedangkan pada tahap implementasi dipergunakan analisis data kevalidan produk dengan menghitung rata-rata skor, analisis data untuk mengukur kepraktisan produk dengan menghitung rata-rata skor dan analisis data untuk mengukur keefektifan pembelajaran. Hasil penelitian menunjukkan bahwa instruksi matematika yang disesuaikan secara signifikan meningkatkan pemahaman konsep dan keterampilan pemecahan masalah siswa dibandingkan dengan metode instruksi tradisional. Siswa yang mendapat instruksi disesuaikan cenderung lebih aktif berpartisipasi dalam pembelajaran, memiliki motivasi lebih tinggi, dan menunjukkan peningkatan yang signifikan pada hasil uji akhir. Hal ini menunjukkan bahwa pendekatan instruksi yang disesuaikan dapat menjadi strategi efektif dalam mengakomodasi keragaman kemampuan siswa, sehingga membantu mencapai hasil belajar yang lebih optimal. Implikasi penelitian ini memberikan dasar bagi kebijakan pendidikan untuk lebih mendukung pelatihan guru dalam penerapan diferensiasi dalam instruksi, terutama pada mata pelajaran yang dianggap sulit seperti matematika.

ABSTRACT

The transition from online learning to limited face-to-face learning requires innovation in learning to increase students' motivation and learning outcomes. This study aims to develop differentiated mathematics learning to improve student learning outcomes and determine the quality of differentiated mathematics learning. This study is a development study using the ADDIE model. The data analysis technique used in this study is for the analysis stage using diagnostic assessment, while at the implementation stage using product validity data analysis by calculating the average score, data analysis to measure product practicality by calculating the average score and data analysis to measure the effectiveness of learning. The results showed that tailored mathematics instruction significantly improved students' conceptual understanding and problem-solving skills compared to traditional instruction methods. Students who received tailored instruction tended to be more active participants in learning, had higher motivation, and showed significant improvements in final test results. This suggests that a tailored instruction approach can be an effective strategy in accommodating the diversity of student abilities, helping achieve more optimal learning outcomes. The implications of this study provide a basis for education policy to further support teacher training in the application of differentiation in instruction, especially in subjects considered difficult, such as mathematics.

1. INTRODUCTION

The Independent Curriculum has been realized since 2021, with the launch of the Driving School program as the seventh episode of the large Independent Learning program from the Ministry of Education and Culture, Research and Technology. The driving school is a pilot project for implementing an independent curriculum. The implementation of an independent curriculum is considered very important in the context of learning recovery after the Covid 19 pandemic, where one of the interventions is student-centered learning. The transition from online learning to limited face-to-face learning requires innovation in learning to generate student motivation and learning outcomes. In previous research findings involving teachers who were interviewed, they found a decrease in student intake as evidenced by symptoms of achieving classical learning goals below 65%, there were still many individual and group assignments that had not been completed. , as well as motivation in participating in activities. Learning is still lacking, as

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evidenced by the fact that there are still students who are absent without explanation, or even skip class (Gaitas & Alves Martins, 2020; Strogilos et al., 2021). One way of student-centered learning is by implementing differentiated learning. Differentiated learning is a form of effort in a series of learning that pays attention to students' needs in terms of learning readiness, student learning profiles, interests and talents. Differentiated learning is a form of effort in a series of learning that pays attention to students' needs in terms of learning readiness, student learning profiles, interests and talents. There are three different learning approaches, namely content, process and product. First, content differentiation is what students learn, related to the curriculum and learning materials. Second, process differentiation is the way students process ideas and information, which includes how students choose their learning style. Third, product differentiation, namely students show what they have learned. Even though differentiated learning is not something new, the implementation of teaching and learning activities is still rarely carried out. To differentiate content, student readiness, interests and learning profiles are used. Tiered activities, creating a variety of activities, and grouping students according to readiness, talent, and interest are all used to carry out the differentiation process. Product differentiation can be done by giving students choices in how to express the desired learning. Differentiated learning is a strategy to meet students' learning needs according to the student's learning style profile. To determine the student's learning style profile, a diagnostic assessment is carried out at the beginning of learning. (Gheyssens et al., 2019; Joseph et al., 2020).

Mathematics is one of the subjects whose success rate is still low. In the field, it is often found that students get low grades in these subjects, students are lazy about completing mathematics subject assignments for reasons of not understanding and being difficult or during the learning process they go in and out of class and carry them out. activities that do not support the mathematics learning process (Gusteti & Neviyarni, 2020; Yuen et al., 2023). From the experience of teaching in high school and the experience of colleagues who are mathematics teachers at SMA Negeri 4 Denpasar, it shows that there are still many students who experience problems in learning mathematics delivered by teachers, so teachers need to apply learning methods that are appropriate to the material being taught. Students are more likely to memorize material than understand concepts. Students memorize new experiences they experience and are not related to previous knowledge that students already have due to previous experiences. Students who learn mathematics by rote learning are not actually learning mathematics, because students do not realize that the accumulated knowledge cannot form an organized understanding of concepts. Many teachers in classroom learning still use conventional methods or models where students are more often silent and listen to the teacher explaining in front of the class(Astuti, 2018; Nurdina Hasanah et al., 2023; Ryan & Bowman, 2022) . Even though the teacher gives students the opportunity to come forward to solve the questions given, only a few students come forward, there are still many students who are silent and don't want to ask questions because they don't understand what they want to ask. This is where teachers must be innovative in choosing learning methods, models and strategies so that students are more motivated in participating in the learning process in class, so it is necessary to apply appropriate learning methods so that the final goal of learning is more meaningful.

Several previous studies have been conducted to examine differentiated learning. 90% of participants reported a greater level of intellectual development and interest in the subject as a result of varied learning strategies. The majority of students in various classes showed evidence of strong understanding of the main ideas covered in the curriculum studies courses, according to student learning outcome assessments. Differentiated instruction increased students' knowledge of challenging calculus concepts and had a favorable impact on motivation and their involvement (Geel et al., 2023; Konstantinou-Katzi et al., 2020). Differentiated teaching is a must before including students with disabilities (SWD) into the general education curriculum. In co-taught early childhood classrooms in Greece, the aim of this study was to describe and assess the variety and quality of curricular changes for SWD. Results indicated that co-teachers planned and implemented more “instructional” modifications than “curricular” or “alternative” modifications, and that co-teachers' and researchers' assessments of the quality of the modifications differed (i.e., the researchers' instruments indicated low quality while teachers believed their modifications met needs SWD)(Rahman & Nasryah, 2020; Safitri et al., 2023) . Different results were shown by several studies that examined teachers' perceptions of the difficulties in using diversified learning tactics in regular classes as part of their research. Five distinct domains were found in teachers' responses after component analysis: activities and resources; evaluation; management; planning and preparation; and class atmosphere. The findings indicated that all teaching approaches in the other categories were considered challenging, except for the classroom environment domain(Peralbo-Uzquiano et al., 2022; Sholihin et al., 2020). The most difficult practices, in particular, fall into the categories of activities and materials and relate to adapting curriculum content, methods, and products to take into account each student's readiness, interests, and learning profile. In elementary

schools in Indonesia, the extent and type of implementation of differentiated learning (DI). Teachers responded to five vignettes reflecting important DI qualities and reported their level of DI implementation. According to research, the overall implementation of DI is still far below the criteria for learning completeness (80%). Nevertheless, teachers believe that they can manage the diversity of their students and have a good understanding of how DI is implemented (Strogilos et al., 2021; Suprayogi & Valcke, 2018). The novelty of this research lies in the application of tailored mathematics instruction to improve student achievement, especially in local contexts that have not yet explored differentiation approaches in mathematics learning. Although adapted instructional methods have been developed in several international contexts, their application in the field of mathematics in classes with a diversity of learning styles and high levels of ability is still rarely implemented in many schools. This research also offers a practical approach for teachers in adapting learning materials and methods to suit students' needs, which has been proven to improve conceptual understanding and problem-solving skills. In addition, this research emphasizes the importance of the student engagement component in differentiated learning, which has not been widely discussed in similar research. By measuring direct impacts on student achievement, motivation, and participation, this research provides empirical evidence that substantiates the effectiveness of personalized instruction in helping students achieve maximum academic potential, while contributing to the development of differentiation theory in mathematics education. Based on the background and gaps in previous research, this research aims to develop differentiated mathematics learning in order to improve student learning outcomes and determine the quality of differentiated mathematics learning in order to improve student learning outcomes.

2. METHOD

This research is a type of research and development (R&D) which aims to produce certain products, and test the effectiveness of these products. The development model used in this research is the ADDIE development model. The ADDIE development model consists of five stages which include analysis, design, development, implementation and evaluation. The data collection techniques used in this research are as follows. First, a student response questionnaire to determine the level of practicality of the device being developed. The questionnaire consists of 20 question items with 4 answer categories, namely strongly agree (SS), agree (S), disagree (TS) and strongly disagree (STS). Second, the test is used to determine the effectiveness of the process differentiation mathematics learning developed. Third, an expert validation sheet consisting of 5 assessment aspects. The research procedure starts from, The first stage is a needs analysis, where researchers identify existing student characteristics and obstacles in mathematics learning. Next, the researcher designed an adjusted instruction model based on the results of the analysis, including varied learning materials, methods and media. After that, a model trial was carried out in class involving a group of students as respondents. The data collection process is carried out through observation, interviews and learning outcomes tests to measure the effectiveness of the model applied. The results of the pilot were then analyzed to evaluate the impact of adapted instruction on student achievement. Finally, the researcher made revisions and improvements to the instruction model based on the feedback received, before preparing a research report containing recommendations for wider implementation in schools. The data analysis technique used in this research is that for the analysis stage a diagnostic assessment is used (Peralbo-Uzquiano et al., 2022; Sholihin et al., 2020). Meanwhile, at the implementation stage, product validity data analysis is used by calculating the average score, data analysis is used to measure product practicality by calculating the average score and data analysis is used to measure effectiveness. learning by comparing it with the school's KKM score, which is 60.

3. RESULT AND DISCUSSION

Result

In this research, differentiation of mathematics learning on the level of material difficulty was developed or classified as process differentiation mathematics learning on trigonometry material. In its development, the model used is the ADDIE model with a description of the results at each stage as follows At this analysis stage, diagnostic tests are carried out. The results of diagnostic tests carried out at the initial analysis stage include 2 types of tests, namely multiple intelligence tests and learning style tests. The results of the multiple intelligence test of the trial class were 28 students or 70% had physical kinesthetic intelligence, 3 students or 7.5% had interpersonal intelligence, 3 students or 7.5% had intrapersonal intelligence, 2 students or 5% had linguistic intelligence, 2 students or 5% have linguistic intelligence, 2 students or 7.5% have linguistic intelligence. students or 5% have visual-spatial intelligence, 1 student or 2.5% have logical-mathematical intelligence and 1 student or 2.5% have

naturalist intelligence. The research class multiple intelligence test results showed that 9 students or 22.5% had interpersonal intelligence, 5 students or 12.5% had linguistic intelligence, 5 students or 12.5% had logical-mathematical intelligence, 5 students or 12.5% had visual spatial intelligence, 5 students or 12.5% have naturalist intelligence, 4 students or 10% have musical intelligence, 4 students or 10% have intrapersonal intelligence and 3 students or 7.5% have physical kinesthetic intelligence. Based on the results above, it can be concluded that multiple intelligences dominate both classes, namely physical kinesthetic and interpersonal. The results of the multiple intelligence test for the trial class and research class are presented in Figure 1.

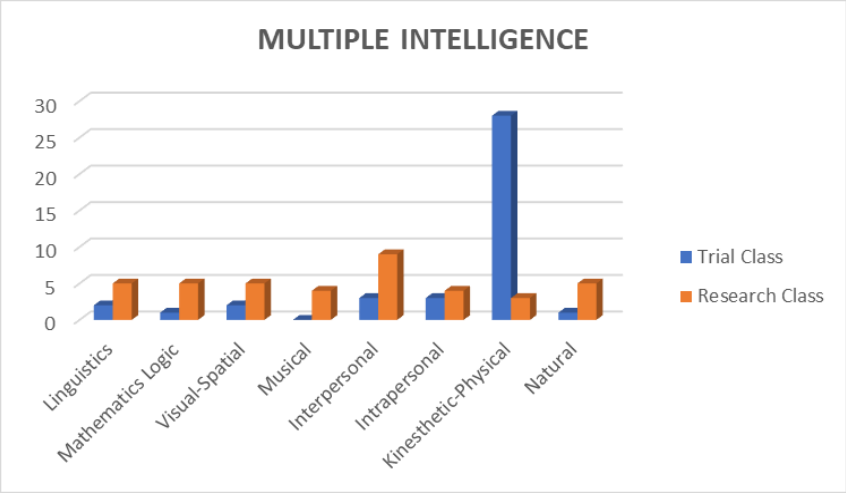

Figure 1. Multiple Intelligence Test Results

The results of the trial class learning style test showed that 16 students or 40% had an auditory learning style, 11 students or 27.5% had a kinesthetic learning style, 5 students or 12.5% had a visual learning style, 3 students or 12.5% had a visual learning style, 3 students or 12.5% have a visual learning style, 3 students or 12.5% have a visual learning style. 7.5% have an auditory-kinesthetic learning style, 3 students or 7.5% have an auditory-visual learning style and 2 students or 5% have a visual-kinesthetic learning style. For the following research class, the results of the learning style test are 14 students or 35% have an auditory learning style, 8 students or 20% have a visual learning style, 8 students or 20% have a kinesthetic learning style, 4 students or 10% have a visual kinesthetic learning style, 3 students or 7.5% have an auditory-kinesthetic learning style and 3 students or 7.5% have an auditory-visual learning style. Based on the results above, it can be concluded that the dominant learning style in both classes is the auditory learning style. The results of the learning style test in the trial class and research class are presented in Figure 2.

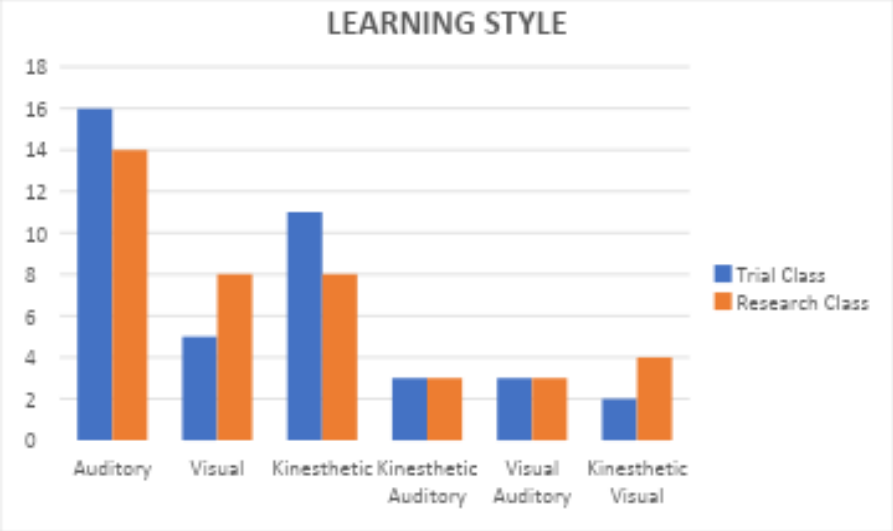

Figure 2. Learning Style Test Results

Based on the results at the analysis stage, the data obtained regarding students' multiple intelligences was dominated by the physical-kinesthetic type in the trial class and the interpersonal type in the research class and the student learning style data was dominated by the interpersonal intelligence type in the research class. auditory types in both classes, namely trial and research. Based on the data on intelligence and learning styles, differentiated learning was developed in the form of learning materials with differentiated levels of material difficulty. To accommodate students with auditory and visual learning styles, it is facilitated with teaching materials delivered in the form of learning videos which are also uploaded to the mathematics subject teacher's YouTube account. The display of learning videos on YouTube is presented in Figure 3. Examples of practice questions based on level of difficulty are presented in Figure 4, and Figure 5.

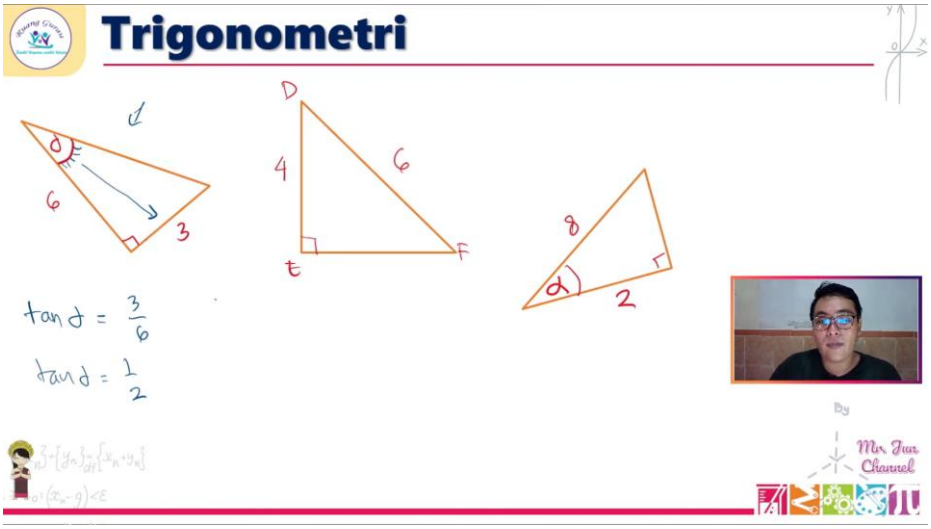

Figure 3. Display of learning videos on YouTube

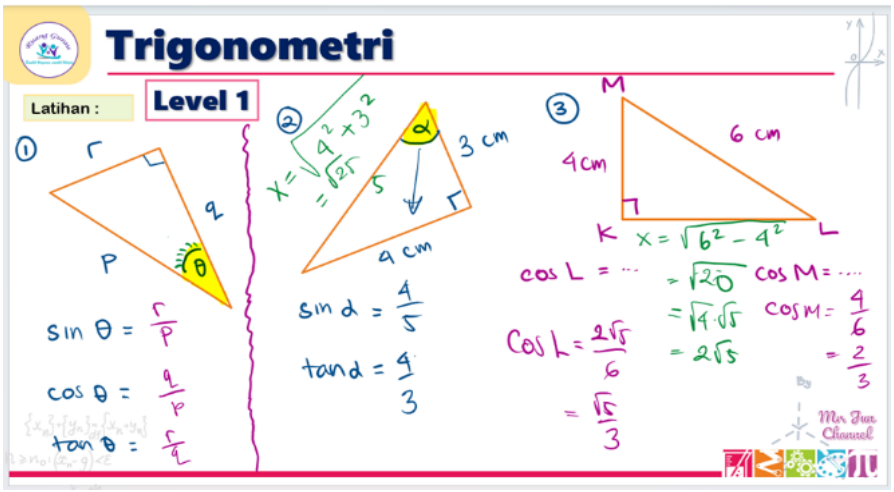

Figure 4. Display of questions with Level 1 difficulty level

From the picture above, it can be seen that by providing variations in practice questions based on the level of difficulty, students are required to be able to improve their understanding and application of concepts to the questions given. Providing several practice questions at various levels provides an opportunity for students who are able to understand and solve level 1 questions to proceed to level 2 questions and so on. Other students are also given the opportunity to explore the material more deeply by working on practice questions at various levels. At this development stage, the draft that had been prepared was validated by two experts, namely the mathematics subject teacher at SMAN 4 Denpasar, namely Desak Prami, S.Pd and the PSP Mathematics Education lecturer at FKIP Unmas, namely Putu Suarniti Noviantari, S.Pd., M.Pd. . with the results of product validity data analysis, namely 3.825, it is classified in the very valid category using an expert validation sheet.

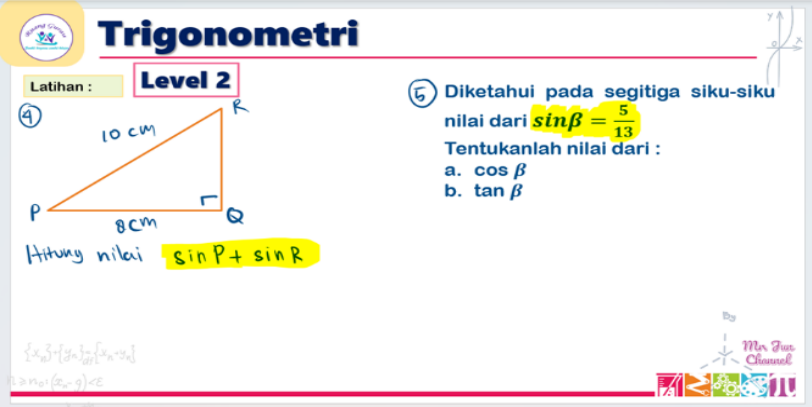

Figure 5. Display of questions with Level 2 difficulty level

The implementation stage was carried out in 2 classes, namely the trial class (X.4) and the research class (X.3) by obtaining product practicality data and product effectiveness data. Where the results of product practicality data analysis for the trial class were 3,095 and for the research class were 3,165, both of which are included in the practical category. For Product Effectiveness data, the results of product effectiveness data analysis in the form of student learning test results in the trial class obtained an average of 66.5 with an increase of 11.375, namely from an average of 55.125 to 66.5 and in the research class an average of 66.5 was obtained. 69. with an increase of 12,375, namely from an average of 56,625 to 69. The results of this effectiveness data analysis are presented in Table 1.

Table 1. Product Effectiveness Data

	Prates	Posts	Improvement
Trial Class	55.125	66,5	11.375
Research Class	56.625	69	12.375

Apart from the results of data analysis on the practicality and effectiveness of the product, based on the results of interviews/interviews conducted after students had studied by applying content differentiation mathematics learning, namely teaching materials with differences in material difficulty for Trigonometry teaching materials, it was stated that students felt challenged by variations in practice questions based on level of difficulty. , students also have various practice questions for trigonometry teaching materials. The teacher also said that variations in practice questions based on level of difficulty provide opportunities for students to explore themselves and accommodate students who have high abilities to explore their potential or abilities. For this evaluation stage, based on the data results, product validity, product practicality and product effectiveness have met the specified criteria. Namely, product validity data reaches the very valid category, product practicality data reaches the practical category and product effectiveness data exceeds the KKM, namely 69.

Discussion

After developing differentiated learning based on the ADDIE stage, the characteristics of differentiated learning produced in this research are learning that accommodates all student learning styles and provides several alternatives or levels of questions which are expected to increase student learning motivation which will have an impact on improving learning outcomes. Student (Amalia et al., 2023; Kristina, 2016; Rijal & Oktaviani, 2017). The success of this development research can also be seen from the validity of the instrument developed which has shown a very valid category according to two experts. In terms of practicality, it can be seen from the results of the student response questionnaire which shows the practical category in both classes. Furthermore, in terms of effectiveness, it can be seen from the student learning outcomes in both classes that are greater than the specified KKM (Pasinggi & Thuken, 2019; Selian & Rambe, 2022). The results of this research are in line with previous research which states that differentiated learning is more interesting and can improve student learning outcomes and differentiated learning can be used in Mathematics learning because it can accommodate students' tailored learning needs. with student learning styles (Ananda, 2018; Kdise et al., 2021; Nuhung, 2016). The implications of this research indicate that implementing tailored mathematics instruction can be an effective approach to increasing student achievement, especially in classes that have a diversity of abilities and learning styles. For educators, these results suggest the importance of designing learning programs

that are flexible and responsive to individual student needs. Tailored instruction can also motivate students to be more active in the learning process, strengthen their engagement, and encourage independent learning. In addition, these findings provide a basis for educational policies to better support teacher training in implementing differentiation in instruction, especially in subjects that are considered difficult such as mathematics. With policy support, schools can more easily provide teachers with the resources and tools they need to implement personalized instruction. Overall, the implications of this research reinforce the importance of an individualized and flexible approach to learning in order to achieve improvements in the quality of education and student learning outcomes. Limitations of this study include the limited sample size, which only included a group of students from one school, so the results may not be generalizable to a wider population. Additionally, the short duration of the study may not be sufficient to evaluate the long-term impact of tailored mathematics instruction on student achievement. External factors, such as parental support and learning environment conditions, which can influence student learning outcomes were also not fully controlled in this research. Another limitation is the variation in the implementation of instructional models in the field, which depends on the ability and experience of each teacher in implementing the strategies that have been designed. Based on these limitations, recommendations for further research are to involve more schools and students from various backgrounds to strengthen the validity and generalization of the results. Longer-term research also needs to be conducted to evaluate the effectiveness of the instructional model over a longer period of time, including its impact on students' advanced mathematics skills. In addition, it is important to consider and control external variables that may influence learning outcomes so that more accurate analyzes can be carried out. Providing adequate training and support to teachers in implementing adapted instructional models is also highly recommended, so that they are more confident and effective in teaching. Finally, conducting regular evaluations and reflections after implementing the model will help identify areas that need improvement and adapt learning strategies to students' evolving needs.

4. CONCLUSION

The development of differentiated mathematics learning that was successfully carried out in this study was differentiated mathematics learning at the level of difficulty of the material included in differentiated mathematics learning content to improve student learning outcomes in trigonometry material. The product validity data obtained was very valid using the expert validation sheet. The practicality data of the product obtained for the trial class was included in the practical category. The effectiveness data of the product in the test class obtained an increase.

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