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The Utilization of Mathematics Digital Learning Media: GeoGebra, Desmos, and Symbolab in Junior High School

Santri Chintia Purba[1]*, Verdinando Taek[2], Novi Suranti[3], Dimas Cristopel[3]
[1]Pendidikan Matematika, Universitas Kristen Indonesia, Indonesia, Santri.purba@uki.ac.id
[2]Pendidikan Matematika, Universitas Kristen Indonesia, Indonesia, verdinandotaek@gmail.com
[3]Pendidikan Matematika, Universitas Kristen Indonesia, Indonesia, nvisrnti03@gmail.com
[4]Pendidikan Matematika, Universitas Kristen Indonesia, Indonesia, dimascristopel@gmail.com

*Correspondence author

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Abstract

The primary issue encountered by the partner in this community service program is the lack digital learning media in mathematics instruction. At the junior high school level, particularly in Grade VII, students are undergoing a transition from concrete to abstract mathematical thinking, which necessitates the use of technology to help them visualize algebraic forms through graphs and various geometric representations of mathematical concepts. This community service program aims to enhance the quality of mathematics learning through the use of digital-based instructional media. The implementation consisted of several stages, namely school needs assessment, training on the use of digital applications, classroom mentoring by facilitators, and evaluation through questionnaires and interactive quizzes. The results of the program indicate that 161 students responded positively to digital-based mathematics learning. This is evidenced by the following findings: 93,16% of students reported enjoying the learning activities; 96,89% expressed interest in using GeoGebra, Desmos, and Symbolab; 93,16% stated that they understood how to use these applications; 83.85% agreed that the material presented was aligned with their learning needs at school; and 85,71% noted that the applications were easy to access. Thus, nearly all students experienced lessons that were engaging, enjoyable, and easy to understand. However, the level of student participation during question-and-answer sessions still needs improvement. Supporting factors of the program included students' enthusiasm, teacher involvement, and the availability of digital devices. Meanwhile, the main inhibiting factors were the limited technological literacy of some teachers and the large number of participants, which restricted interactive engagement. Overall, the program had a positive impact on the quality of digital-based mathematics learning

Keywords: digital learning, mathematics, Geogebra, Desmos, Symbolab

Abstrak

Permasalahan dialami mitra dalam pengabdian ini adalah tidak adanya penggunaan dan pemanfaatan media pembelajaran digital dalam pembelajaran matematika. Tingkat SMP yang secara khusus kelas VII yang mengalami transisi dari konkrit ke dalam abstrak matematis memerlukan penggunaan teknologi yang membantu siswa untuk melihat bentuk nyata aljabar dalam bentuk grafik dan berbagai bentuk geometris dari konsep matematika. Program pengabdian kepada masyarakat ini bertujuan untuk meningkatkan kualitas pembelajaran matematika melalui pemanfaatan media pembelajaran berbasis digital. Pelaksanaan program dilakukan melalui beberapa tahapan, yaitu observasi kebutuhan sekolah, pelatihan penggunaan aplikasi digital, dan pendampingan di kelas oleh fasilitator, serta dievaluasi melalui angket dan kuis interaktif. Hasil kegiatan menunjukkan bahwa siswa memberikan respons positif terhadap pembelajaran matematika berbasis digital. Hal ini terlihat dari 93,16% siswa merasa senang dengan aktivitas pembelajaran, 96,89% tertarik menggunakan media desmos, symbolab dan geogebra, 93,16%

siswa menyatakan memahami penggunaan media desmos, geogebra dan symbolab, 83,85% siswa menyatakan materi yang dijelaskan sesuai dengan kebutuhan pelajaran di sekolah, dan 85,71% menyatakan bahwa aplikasi mudah diakses. Jadi, hampir semua siswa mengalami pembelajaran yang menarik, menyenangkan, dan mudah dipahami. Namun, tingkat partisipasi siswa selama sesi tanya jawab masih perlu ditingkatkan. Faktor pendukung program meliputi antusiasme siswa, keterlibatan guru, dan ketersediaan perangkat digital. Sementara itu, faktor penghambat utama adalah keterbatasan literasi teknologi beberapa guru dan jumlah peserta yang besar, yang membatasi keterlibatan interaktif. Secara keseluruhan, program ini berdampak positif pada kualitas pembelajaran matematika berbasis digital.

Kata Kunci: *pembelajaran digital, matematika, geogebra, desmos, symbolab*

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Introduction

The development of digital technology has brought significant changes to various aspects of human life, including the field of education. The use of information and communication technology in the learning process has become an inevitable necessity (Junaedy et al., 2021). The integration of such technology is essential because it is already deeply embedded in students' daily lives. Through the incorporation of digital technology, the teaching and learning process can become more interactive, effective, and aligned with the characteristics of learners (Hendra Agung Saputra Samaloisa & Dyulius Thomas Bilo, 2024). Even mathematical content, which is often perceived as abstract and calculation-heavy, now makes use of various technological tools as learning media.

Mathematics, as one of the core subjects, plays a crucial role in developing students' logical, analytical, and critical thinking skills (Aksu & Koruklu, 2015). However, in practice, many students still perceive mathematics as a difficult and uninteresting subject. Conventional teaching approaches, such as lectures and routine exercises, often lead to student disengagement. Therefore, innovative learning strategies are needed to make the mathematics learning experience more enjoyable, interactive, and contextual (Purba et al., 2023).

SMP Negeri 80 Jakarta is one of the junior high schools in DKI Jakarta that has great potential for implementing digital-based learning. However, the use of digital media in mathematics instruction has not yet been optimized. Teachers often encounter various obstacles in using technology due to limited knowledge of appropriate applications that can support learning. Both teachers and students require training and guidance in integrating various digital platforms such as GeoGebra, Quizizz, Kahoot!, and Google Classroom into the teaching and learning process (Ditasona et al., 2025).

One of the main problems lies in the limited digital competence of teachers. Many mathematics teachers are still unfamiliar with technology-based learning platforms and applications. The only digital tool commonly used at school is Artificial Intelligence (AI) such as Gemini. However, technology-based learning media—whether web-based or software-based—are not yet utilized in classroom instruction. As a result, students who are already digital natives, particularly in using smartphones, cannot fully take advantage of technology to support their mathematics learning. This condition leads to predominantly conventional instruction, characterized by teacher-centered lectures and repetitive worksheets, which decreases student motivation to actively participate in the learning process.

Furthermore, the shift toward the Kurikulum Merdeka presents new challenges, particularly the demand for creativity and innovation in learning practices (Rambung et al., 2023). Digital media also supports differentiated and contextual learning, which is a fundamental component of the Kurikulum Merdeka (Ulya et al., 2025).Teachers are expected to integrate technology and project-based approaches to enhance students' numeracy skills and critical thinking. However, the limited training and assistance in applying digital technology within the context of mathematics learning has hindered optimal curriculum implementation.

Digital technology has been identified as having three main didactic functions in mathematics instruction (Putrawangsa & Hasanah, 2018):

1. As a tool for performing mathematical activities, where technology is used as an alternative learning medium to carry out various mathematical tasks.
2. As a tool for skill development, where technology functions as a learning environment that helps students master specific mathematical skills.
3. As a medium for building conceptual understanding, in which technology is integrated into the learning process to strengthen students' comprehension of particular mathematical concepts.

More broadly, there is also a growing global demand for the integration of artificial intelligence (AI) in education (Sucianingtyas et al., 2025). AI technology has begun to be used in various aspects of learning, including automated assessment systems, adaptive learning, and applications that support mathematical problem solving. However, the misuse of AI in learning is also increasingly prevalent; students often rely on AI to complete assignments without engaging in the thinking process themselves. Teachers also struggle to detect AI-generated work due to limited literacy in AI and other digital technologies. Thus, teachers' digital literacy needs to be strengthened through training, and students must be taught to use digital media responsibly to support proper mathematical thinking processes.

Through the training implemented, teachers are expected to master several technological tools that can be applied in classroom mathematics instruction, such as Desmos, Symbolab, and GeoGebra.

Desmos is a digital mathematics learning platform capable of representing various mathematical forms such as function graphs, plane shapes, and circle angles. Its use can improve students' mathematical abilities (Rahmadhani et al., 2022).

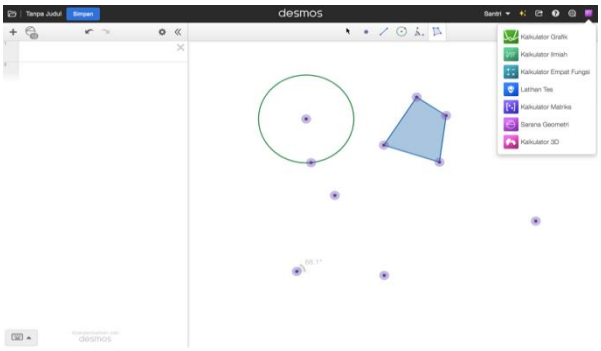

Figure 1. *Desmos Interface*

Symbolab is an online mathematics calculator that can automatically solve mathematical problems along with step-by-step solutions. It is widely used by students, university learners, and teachers due to its ability to handle problems ranging from basic to advanced levels. The

use of Symbolab in learning can develop students' mathematical reasoning abilities (Agustin et al., 2023).

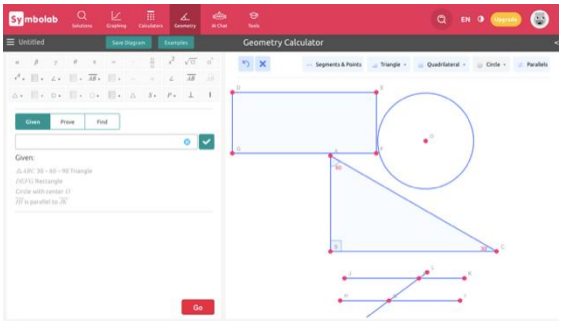

Figure 2. *Symbolab Interface*

GeoGebra is a dynamic mathematics software used for teaching and learning various mathematical concepts, including geometry, algebra, statistics, and calculus. It is free, multiplatform, and widely used in education. GeoGebra has been shown to enhance students' conceptual understanding, motivation, learning interest, and even problem-solving skills (Fathurrahman & Fitrah, 2023).

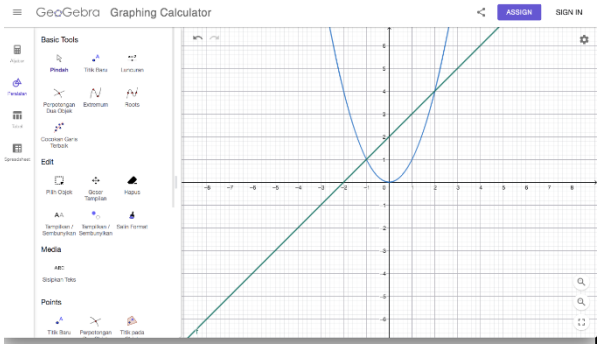

Figure 3. *GeoGebra Interface*

Through training on these three digital mathematics learning tools, the learning process is expected to become more enjoyable and to improve teachers' digital literacy in mathematics instruction. These platforms are easily accessible and free, enabling both teachers and students to enhance the quality of mathematics learning—transforming a subject often perceived as difficult into one that is engaging and enjoyable.

Method

The methods used in community service programs generally include outreach, training, facilitation, development of appropriate technology, and the implementation of social innovations. These methods are employed to apply the knowledge and expertise of higher education institutions in addressing social, economic, educational, or public health issues through direct and participatory engagement with the community. This Community Service Program was implemented through a series of structured stages designed to ensure the effectiveness, relevance, and sustainability of digital-based mathematics learning at SMP Negeri 80 Jakarta. The method consisted of four primary phases: observation, material delivery, hands-on training, and classroom facilitation.

1. Observation Phase
   The initial stage, conducted on 10 October 2025, aimed to identify the needs and challenges faced by the partner school. Data were collected through interviews with mathematics teachers, which revealed limited use of digital learning media due to the unavailability of appropriate tools and insufficient digital literacy among teachers, particularly in technology-based mathematics learning. The findings served as the basis for designing the subsequent training program focused on enhancing teachers' and students' competency in utilizing digital platforms.
2. Material Delivery
   The second phase took place on 30 October 2025 and involved the presentation of foundational concepts related to digital transformation in mathematics education, especially within the context of the Kurikulum Merdeka and current technological advancements. Participants consisted of mathematics teachers, Grade VII homeroom teachers, and 282 Grade VII students. This session introduced the participants to essential digital tools such as GeoGebra, Desmos, and Symbolab, and emphasized their pedagogical value in supporting interactive and meaningful learning.
3. Digital Media Training
   A workshop session was conducted to provide direct practice using digital applications. Teachers and students used their personal devices to explore the features and functionalities of GeoGebra for algebra and geometry visualization, Desmos for graphing functions, Symbolab for symbolic computation and graphing, and Kahoot! for interactive formative assessment. This stage ensured that participants gained practical skills to integrate the tools into classroom learning.
4. Classroom Facilitation and Implementation
   From 30 October to 4 November 2025, facilitatorsis pre-service teachers conducting their teaching practicum-assisted in classroom implementation. They supported teachers and students in utilizing digital media during mathematics lessons and conducted learning evaluations through Kahoot-based quizzes. This phase provided real-time monitoring of students' engagement and comprehension.

Results and Discussion

The Community Service Program was conducted through several stages, namely Observation, Training, and Classroom Implementation. The observation stage was carried out on October 10, 2025 to identify the school's needs. Information was obtained through an interview with one of the mathematics teachers, who explained that the use of digital-based learning media in the school was still minimal due to the unavailability of appropriate technological tools and the limited digital literacy of teachers—particularly mathematics teachers—regarding technology-based mathematics learning. Based on these observations, it was concluded that digital media training for mathematics instruction was necessary.

The second stage involved the implementation of the PkM program through a material presentation session held on October 30, 2025. The participants included mathematics teachers, Grade VII homeroom teachers, and 282 Grade VII students. The data on Grade VII student participants can be seen in Figure 4.

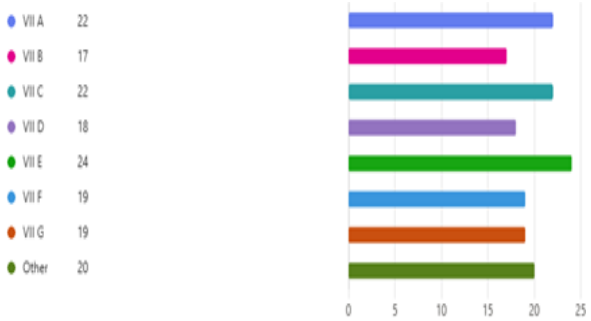

Figure 4. *The audience of the activities*

The presentation session was conducted through a training program titled "Enjoyable Digital-Based Mathematics Learning." The activity took place in the main hall of SMP Negeri 80 Jakarta, located in the Halim Perdana Kusuma area.

The next stage involved classroom assistance by facilitators, who were university students assigned to classrooms from October 30 to November 4, 2025. These facilitators were undertaking their teaching practicum at the school, allowing them to help implement digital-based learning in classrooms and conduct evaluations using Kahoot games to assess students' understanding of the digital media introduced by the presenters.

The Community Service Program was officially held on October 30, 2025 in the main hall of SMP Negeri 80 Jakarta and was attended by 161 students and 5 mathematics teachers.

To ensure that the objectives and expected outcomes were achieved optimally, the program was carried out through several systematic stages, as described below:

1. Preparation Stage

The initial stage focused on planning and coordination to ensure effective implementation. Activities included: 1) Coordinating with the partner school to explain the objectives, benefits, and schedule of the program; 2) Identifying the needs of teachers and students regarding digital-based mathematics learning, including their level of technological understanding and the challenges faced; 3) Preparing program materials such as presentations, training modules, user guides for digital applications (GeoGebra, Desmos, Symbolab), and evaluation instruments; 4) Forming an implementation team consisting of lecturers and students from the Mathematics Education Study Program, FKIP UKI, assigned to various roles such as presenters, facilitators, documenters, and evaluators.

2. Presentation Stage

This stage introduced the concepts and urgency of digital-based mathematics learning. The speaker delivered an explanation regarding the importance of digital-based learning in the era of the Kurikulum Merdeka and its relevance to current technological developments. Teachers and students were introduced to various digital platforms such as GeoGebra, Desmos, and Symbolab. This explanation received positive responses from students, as many of them had never used some of these applications directly before. Activities included: 1) Delivering the main material on the importance of digital transformation in mathematics instruction in the era of the Merdeka Curriculum and the advancement of AI; 2) Conducting interactive

discussions with mathematics teachers and students regarding challenges in conventional instruction and opportunities for integrating digital technologies into the classroom.

Figure 5. *Presentation by the Speaker*

3. Training Stage

This stage involved hands-on practice using digital devices. Teachers and students practiced using GeoGebra, Symbolab, and Desmos by using phones. The workshop covered:

1. GeoGebra for visualizing geometric and algebraic concepts,
2. Desmos for graphing functions,
3. Symbolab for graphing and generating step-by-step mathematical solutions,

Figure 6. *Training and Hands-On Practice Using Mobile Phones*

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4. Classroom Facilitation Stage

This stage ensured that students were able to apply what they had learned during the training in real classroom situations. Facilitators (university students) supported the implementation of digital media and strategies in classrooms. They used digital applications during lessons and conducted evaluations using Kahoot, as shown in Figure 7.

Figure 7. *Classroom Facilitation by Student Facilitators*

The questionnaire results indicate that respondents came from all Grade VII classes with a relatively balanced distribution. Class VII E contributed the highest number of respondents. This finding shows that the activity was attended by almost all Grade VII students, allowing the evaluation results to be considered representative of the entire cohort, as illustrated in Figure 4 above.

Based on the students' responses, it was found that they demonstrated positive attitudes toward the training. The training objectives were achieved, particularly in fostering enjoyable mathematics learning through the use of digital media. This is reflected in the survey questionnaire results, presented in the following table:

***Table 1**. The questionare result for each instruments item*

No	Statement items	Average
1	I enjoyed the mathematics learning activities conducted	3,18
2	I was interested in the material presented	3,22
3	I was interested in using the digital media introduced	3,41
4	I actively participated in the learning activities	3,02
5	I paid close attention to the explanation	3,25
6	I asked questions when I did not understand	3,05
7	I enjoyed learning through games	3,61
8	I understood the material that was presented	3,17
9	The material explained was easy to understand	3,19
10	The explanations provided were clear	3,31
11	The material delivered was relevant to school lessons	3,27
12	The teacher delivering the material mastered the content	3,53
13	The digital platforms introduced were easy to access	3,27
14	The digital media used were beneficial for me	3,48
15	I enjoyed digital-based learning in mathematics	3,25

Based on the table above, from the 161 students who completed the questionnaire, the average score for each item exceeded 3. Using a Likert scale of 1 to 4, the results indicate that students' responses toward mathematics learning using digital media tended to be positive. Almost all items obtained mean scores above 3.00, suggesting that students generally agreed with the statements provided. In terms of motivation and interest, students appeared quite enthusiastic about mathematics learning, particularly when digital media and game-based activities were incorporated. This is evident from the high scores for statements related to the use of games (3.61) and the benefits of digital media (3.48). Regarding the learning process, students perceived the explanations as clear and the content as easy to understand, although their level of comprehension remained within a moderately good range (approximately 3.17–3.31). The resource person was also rated as highly competent (3.53), indicating a strong quality of material delivery.

However, student activity in asking questions and participating was relatively lower compared to other aspects (around 3.02–3.05). This is consistent with the large audience size, which limited opportunities for individual interaction (Rogers et al., 2013). This suggests that although students enjoyed the learning process, they were not yet fully engaged in discussions or interactive questioning. From a sociocultural viewpoint, participation in interactive discussions enhances conceptual understanding, boosts student achievement, and fosters higher-order thinking, reasoning, and communication skills (Rosaen et al., 2017). Mathematics

learning supported by digital media was perceived as engaging, clear, beneficial, and facilitated by competent instructors. Students are willing to know the media that support their need during the mathematics learning. Digital learning help students to solve the obstacle on imagine the real picture of some geometry and help students to face their problem easier (Baez et al., 2026). This is reflected in the findings showing that 150 out of 162 students (93.16%) felt enjoy with the learning activities, with an average score of 3.2 out of 4. Furthermore, 156 out of 161 students (96.89%) reported interest in using digital media such as Desmos, Symbolab, and GeoGebra. In addition, 150 out of 161 students (93.16%) stated that they understood how to use Desmos, GeoGebra, and Symbolab. A total of 135 out of 161 students (83.85%) agreed that the material presented aligned with the learning needs at school, and 138 out of 161 students (85.71%) indicated that the applications were easy to access. The result shows that the program about utilization of mathematics digital learning media such as geogebra, desmos, and symbolab in junior high school got positive impact to students (Baez et al., 2026; Chechan et al., 2023; Mollakuqe, 2025). Nonetheless, future improvements may focus on increasing student activeness and participation during the learning process.

Conclusion

The Community Service Program on "Enjoyable Digital-Based Mathematics Learning" at SMP Negeri 80 Jakarta was successfully implemented through a series of stages, including observation, training, facilitation, and evaluation. This program effectively enhanced the digital knowledge and competencies of both teachers and students through the utilization of platforms such as GeoGebra, Desmos, and Symbolab. Survey results indicated that students responded positively to digital-based learning, as reflected in their high levels of interest, motivation, and perceived benefits of digital media. Students felt that the learning process was more engaging, easier to understand, and interactive. This is evidenced by the fact that 150 out of 162 students (93.16%) felt happy with the learning activities, with an average score of 3.2 out of 4. Furthermore, 156 out of 161 students (96.89%) reported interest in using digital media such as Desmos, Symbolab, and GeoGebra. In addition, 150 out of 161 students (93.16%) stated that they understood how to use Desmos, GeoGebra, and Symbolab. A total of 135 out of 161 students (83.85%) agreed that the material presented aligned with the learning needs at school, and 138 out of 161 students (85.71%) indicated that the applications were easy to access. Thus, nearly all students perceived the digital-based mathematics learning activities as more engaging, enjoyable, and easy to comprehend. However, the level of student participation during question-and-answer sessions still needs improvement. Supporting factors of the program included students' enthusiasm, teacher involvement, and the availability of digital devices. Meanwhile, the main inhibiting factors were the limited technological literacy of some teachers and the large number of participants, which restricted interactive engagement. Overall, the program had a positive impact on the quality of digital-based mathematics learning.

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