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TeknoMatika: Technology and product differentiation training to improve mathematics teachers' competence in Pangandaran

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ABSTRACT

This community service program was implemented to address the challenges faced by mathematics teachers in applying differentiated instruction. The program aimed to enhance teachers' competencies in implementing differentiated learning and integrating technology as a teaching aid in mathematics. The training focused on improving teachers' understanding of differentiated instruction, particularly in mathematics education, and equipping them with the skills to utilize technology in the classroom. The methods used included socialization, training, technology implementation, mentoring, and program sustainability. Results showed that 88.2 percent of teachers required technology training, and 80.64 percent expressed interest in participating. Training evaluations revealed an improvement in teachers' ability to identify students' learning styles and develop technology-based learning media. Teachers reported that Kodular facilitated the creation of interactive and student-centered learning tools. The program successfully enhanced teaching effectiveness, student engagement, and teacher creativity, despite technical challenges such as internet connectivity issues. The TeknoMatika Training has the potential to serve as a model for teacher competency development in other regions, contributing significantly to technology-based educational innovation.

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1. INTRODUCTION

The Merdeka Curriculum and differentiated learning are two relevant approaches in the context of modern education. Both aim to make the learning process more effective and prepare students to face the diverse challenges of the future. In Pangandaran Regency, the implementation of these two approaches presents its own challenges that require adaptation and specific innovations tailored to the region's needs. For example, the Merdeka Curriculum emphasizes adaptability, creativity, and flexibility (Bustari, 2023; Hudjimartsu et al., 2021; Majdi, 2023), particularly in utilizing local potential as part of the learning process. One of the local potentials that can be utilized is the data on the production of salted jambal roti, which is relevant for teaching mathematical concepts such as measurement and statistics.

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However, the integration of this local potential is still not optimal due to the limited training teachers have received in developing a locally-based curriculum. Additionally, the lack of intensive guidance has made it difficult to implement contextual teaching materials, causing students to miss out on learning in contexts that are relevant to their everyday lives.

In the implementation of differentiated learning, teachers in Pangandaran also face significant challenges in identifying students' learning needs. As is known, differentiated learning aims to adjust teaching methods to students' learning styles, whether visual, auditory, or kinesthetic (Amalia et al., 2023; Azimah & Sujannah, 2024; Fitriyah & Bisri, 2023). However, most teachers do not have adequate knowledge on how to apply this approach. For example, an initial survey showed that 60 percent of teachers more often use conventional methods like lectures, which rarely involve visual aids or interactive technology. This will certainly have a negative impact on motivation and learning outcomes, particularly for students with visual learning styles who tend to grasp and retain information presented in the form of images, diagrams, graphs, or videos. Without visual aids, these students will not fully capture and retain the information presented orally.

Similarly, students with kinesthetic learning styles, who require physical activity and direct experience to understand the material, are not accommodated by conventional, static methods with minimal interactivity. These methods do not provide opportunities for physical engagement, which can reduce attention and information retention. If differentiated learning is not immediately implemented and conventional static methods continue to be used, it is feared that students will be hindered in developing critical thinking, creativity, and independent learning skills, which are the main objectives of the Merdeka Curriculum. The importance of applying differentiated learning aligns with the views of Himmah & Nugraheni (2023), who state that differentiated learning is essential to ensure that each student receives a learning experience that suits their style and needs. This is further supported by Nurlatifah & Munandar (2024), who emphasize that teachers' ability to identify students' learning styles is crucial in creating effective learning. Without sufficient understanding of students' learning preferences, teachers tend to apply a homogeneous teaching approach, which does not always meet the needs of all students. As a result, students with different learning styles may have difficulty following lessons and understanding the material, making the learning process less optimal, especially in heterogeneous classrooms with significant differences in ability.

The challenges faced by mathematics teachers in Pangandaran Regency are growing, particularly due to their limited knowledge in utilizing technology as a teaching aid. However, technology has significant potential to support the implementation of differentiated learning by providing varied and engaging media. This aligns with the statement of Maulidia & Prafitasari (2023), who assert that in an era of rapid technological development, the use of digital tools in education can be a solution to creating more diverse learning media. One technology used in this training is Kodular, a block-based platform (Yunianta et al., 2023) that allows teachers, even without a programming background, to easily develop interactive learning applications. With Kodular, teachers can design applications that cater to different learning styles such as visual, auditory, and kinesthetic, making learning more inclusive and engaging. Kodular was chosen based on requests from mathematics teachers in junior high schools across Pangandaran Regency, who wanted training on how to use and develop learning media that could meet the diverse needs of students but was still easy to create, time-efficient, and aligned with their limitations in designing or developing learning media. This choice also considered their tight teaching schedules.

Junior high school mathematics teachers in Pangandaran Regency became the main target group for this study, based on needs assessments conducted in southern Priangan, including Tasikmalaya, Ciamis, Banjar, and Pangandaran regions. It was found that the group most in need of attention was the junior high school mathematics teachers in Pangandaran. The junior high school level demands

a more varied approach compared to elementary school, which is still focused on basic mathematics concepts. The importance of implementing this diverse strategy is in line with the findings of Cardino & Ortega-Dela Cruz (2020), who emphasize that effective teaching at the junior high school level must accommodate various student learning styles. This approach not only helps students understand mathematical concepts more deeply but also increases their engagement and active participation in the learning process. Meanwhile, senior high school teachers generally have more experience and often receive additional training, so their need for technological support and differentiation is relatively less compared to junior high school teachers.

Based on these issues, there is an urgent need to strengthen the competencies of mathematics teachers in Pangandaran Regency in understanding and applying differentiated learning and in optimizing the use of technology. This community service program is designed to address the aforementioned needs. Through this program, it is expected that teachers will gain skills in identifying students' learning styles and using technology as a tool for more effective teaching. By doing so, the quality of mathematics education in Pangandaran can improve, in line with technological advancements and the demands of 21st-century learning. The main objective of this program is to enhance teachers' competence in implementing differentiated learning according to students' learning styles and to develop teachers' abilities in using technology to create engaging and effective learning media. By achieving these objectives, it is hoped that the quality of mathematics learning in Pangandaran Regency will improve, thus positively impacting students' competence in understanding complex mathematical concepts.

2. METHODS

This community service activity is carried out by six (6) Mathematics Education lecturers from Universitas Siliwangi (Unsil) Tasikmalaya. The subjects of this community service are all the mathematics teachers at the SMP level in Pangandaran Regency who are members of the MGMP (Subject Teacher Consultation), totaling 31 teachers. The data and tools used during the TeknoMatika training program include: (1) Laptop. Each participant is required to bring a technological device (laptop) to be used during the training; (2) A web-based platform (Kodular) is used to create Android applications without having to write code manually, so that participants can develop learning media quickly and can be downloaded and installed on Android devices; (3) A learning style questionnaire is used to help teachers identify the learning styles of students in their classes.

The training method used in the implementation of this community service activity aims to improve the teachers' competencies in implementing differentiated learning and the use of technology as an aid in mathematics teaching. The activities are carried out through several systematic stages, involving training and intensive mentoring. These stages are presented in Figure 1.

Figure 1. Stages of implementation of the "TeknoMatika" program

Figure 1 shows the sequence of processes that will be followed in the implementation of the "TeknoMatika" program. This program consists of five main stages, starting with Socialization, followed by Training, Technology Application, Mentoring and Evaluation, and ending with Program Sustainability. Each stage is designed to complement each other, with a focus on strengthening teachers' competencies in implementing technology-based differentiated learning in the classroom.

Preparation

The preparation stage will be carried out for approximately two months, from April to May 2024. This stage focuses on the analysis of participant needs so that the training can be more targeted, with three main activities including: (1) Coordination with partners. The initial step in this training activity is coordinating with the Mathematics MGMP at the SMP level across Pangandaran Regency to explain the program's objectives and reach an agreement on the implementation schedule; (2) Needs analysis. Identifying training needs by conducting an initial observation of the conditions and challenges faced by mathematics teachers in implementing differentiated learning; (3) Training material design. After the observation, the training materials will be designed to include concepts of differentiated learning, identifying student learning styles, and using technology in mathematics teaching.

Socialization

Before the socialization is carried out, learning media will be designed based on the information gathered during the preparation stage, which will serve as the foundation for the socialization phase. The process of designing the learning media will take place from May to July 2024, prior to the start of the socialization. The socialization stage aims to provide participants with an initial understanding of the program that will be implemented and will be conducted over one month, in May 2024. The socialization activities include: (1) Presentation of the program's objectives and benefits. Teachers will be introduced to the basic concepts of differentiated learning, the importance of identifying students' learning styles, and the application of technology in mathematics education; (2) Introduction to the activity schedule. Participants will be given an explanation of the schedule and how to participate in the program.

Training

After the socialization stage is successfully carried out and participants understand the objectives and benefits of the training program, the next activity focuses on strengthening the teachers' competencies through training held on July 18, 2024. In this stage, teachers will be equipped with knowledge and skills in developing learning media using the Kodular application, which can support the implementation of differentiated learning.

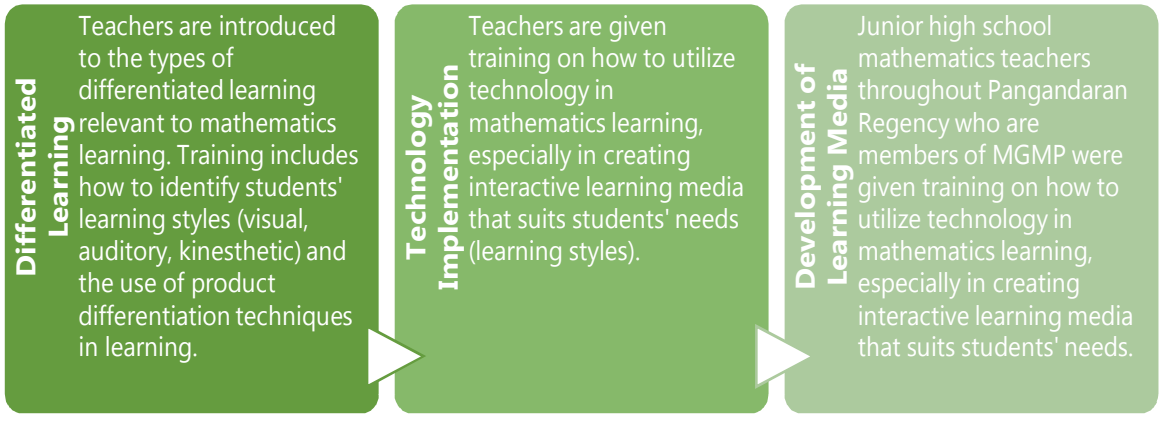

Figure 2. TeknoMatika training stage process

Technology Implementation

This stage is a crucial activity in the implementation of the TeknoMatika program. The main focus of this stage is to equip mathematics teachers at the junior high school level in Pangandaran District with practical skills to use technology in teaching mathematics in the classroom, thereby supporting more effective differentiated learning. Teachers are encouraged to create technology-based learning media according to students' learning styles (visual, auditory, kinesthetic) with materials tailored to the individual needs of each student. They will then apply the developed media into the classroom learning process to observe how technology can help explain abstract mathematical concepts.

Mentoring and Evaluation

After the training is completed, it is crucial to ensure that the junior high school mathematics teachers in Pangandaran District can effectively apply the knowledge and skills they have gained in real learning situations. To ensure successful implementation, continuous mentoring is required. In this case, the mentoring stage aims to support teachers in addressing challenges and obstacles that may arise during the application process while providing opportunities for adjustments based on needs. This stage will also include evaluations to assess the progress of teachers in implementing differentiated learning and technology in the classroom.

Here are the details of the mentoring and evaluation stages: (1) In the mentoring stage, teachers are guided in developing differentiated learning media using the Kodular app, with content tailored to the teachers' needs; (2) Subsequently, periodic evaluations will be conducted to assess the extent to which teachers have successfully developed and applied learning media that align with students' learning styles. Feedback will also be provided for further improvement.

Program Sustainability

The final stage is to ensure the sustainability of the program by encouraging teachers to continue developing differentiated learning media independently. This activity includes the formation of a WhatsApp group so that teachers can communicate with trainers when facing challenges, as well as share experiences, challenges, and solutions in developing differentiated learning media using Kodular, considering students' learning styles. Additionally, evaluation rubrics will be used to assess the progress of participants in applying the media they have developed and the differentiated products in the learning process.

3. RESULTS AND DISCUSSION

Results

Based on the results of the questionnaire conducted in the first stage, namely preparation, as shown in Figure 3, as many as 88.2 percent of junior high school mathematics teachers in Pangandaran Regency, who are members of MGMP, stated the need for technology-based training and product differentiation. The results of this questionnaire assess several aspects, such as skills in using technology, development of learning media, and understanding of differentiated learning.

Findings regarding the skills gap in the use of technology indicate that teachers are not yet fully able to implement product-differentiated learning optimally.

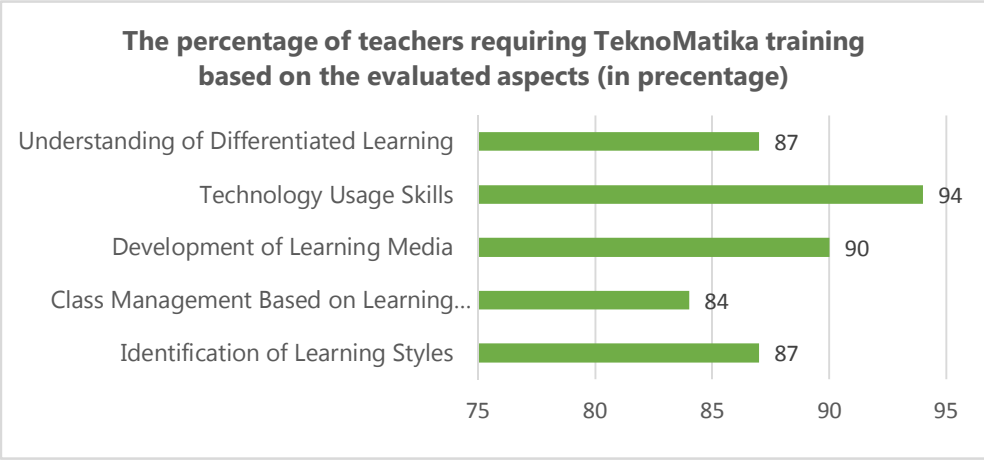

Figure 3. Results of the questionnaire on the needs of junior high school mathematics teachers throughout Pangandaran Regency

The second stage is socialization, which was held in the Pangandaran Regency Education Office Hall, the objectives and benefits of the training were explained to 31 mathematics teachers who are members of the MGMP. The teachers were given an overview of the training program that will take place. The results showed that the majority of teachers were interested in participating in technology-based and product-differentiated training.

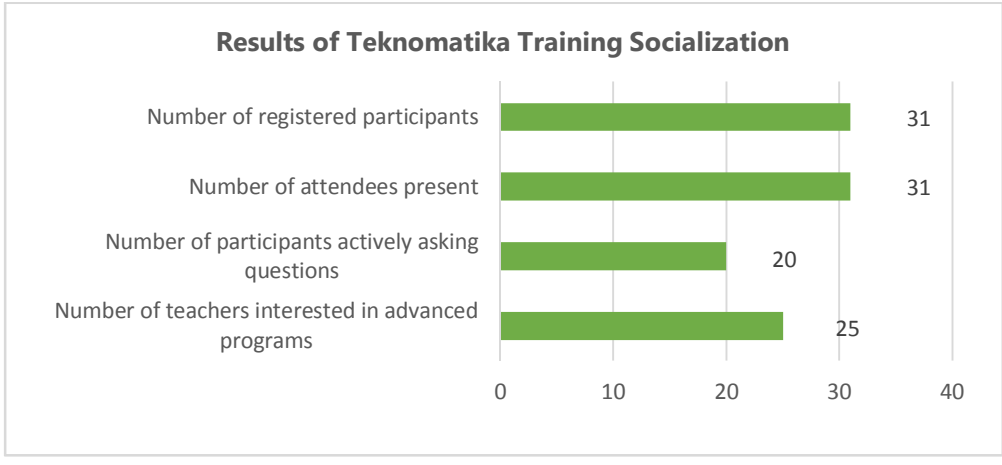

Figure 4. Results of the socialization of TechnoMatika training

Based on Figure 4, it can be seen that as many as 80.64 percent or equivalent to 25 junior high school mathematics teachers in Pangandaran Regency have a high interest in participating in the TeknoMatika training program.

The third stage is training. This Teknomatika training is carried out through several sessions that include an introduction to the concept of differentiated learning, the use of questionnaires to determine learning styles, and the use of kodular to create applications.

Figure 5. Providing TeknoMatika training materials

The main focus of the TeknoMatika training is to help mathematics teachers throughout Pangandaran understand how to effectively identify students' learning styles, whether visual, auditory, or kinesthetic. This identification is a crucial first step in creating more personalized and responsive learning tailored to each student's needs. By understanding students' learning preferences, teachers can more easily adjust their teaching methods and the materials presented, ensuring that the learning process is more optimal and efficient. In addition to understanding learning styles, the teachers are also taught to develop learning media that are not only visually engaging but also relevant and aligned with students' needs in enhancing their understanding of the subject matter. This is important because effective learning media can act as a bridge between students and the material being taught, helping them to grasp difficult and abstract concepts more easily. The learning media developed in this training uses Kodular, a block-based platform that allows teachers to create Android-based learning applications without requiring extensive programming knowledge.

Figure 6. Creating learning applications with Kodular

With Kodular, teachers can create interactive and dynamic applications, such as quizzes, simulations, or visual aids, which can be accessed by students through their Android devices. These applications are designed to support both independent and collaborative learning, where students can learn anytime and anywhere, both inside and outside the classroom.

After completing the entire training series, the next step is the training evaluation. Based on the evaluation results, there are several findings that can serve as a basis for improvements in future training programs, including: Although most participants felt that the training was very beneficial, about 10 percent of the participants encountered technical difficulties, particularly related to internet connection issues. This obstacle hindered the smooth implementation of online practice for some participants,

especially when downloading and using the Kodular Companion application. However, this feedback is crucial for ensuring better infrastructure in future training programs. Feedback results showed that 85 percent of participants felt that the material presented was highly relevant to their teaching needs. Participants also stated that using Kodular provided a practical solution for creating more dynamic learning media without requiring a programming background.

Figure 7. Teknomatika training participant discussion and feedback session

To ensure the sustainability of the TeknoMatika program, junior high school mathematics teachers in Pangandaran Regency who have participated in the training are expected to be able to develop learning media independently using the Kodular platform. By using Kodular, each teacher has the freedom to choose or adjust materials according to the needs and characteristics of students in their school. This is expected to strengthen teachers' ability to utilize technology to design interactive learning media that is in accordance with the curriculum and learning objectives.

Figure 8. Independent implementation of learning media development using Kodular

This step also aims to encourage teachers' creativity in integrating technology into the teaching and learning process, providing students with a more engaging and contextual learning experience. Additionally, with teachers' ability to develop learning media independently, the sustainability of this program is not limited to the initial training but continues along with the need for professional development. This also has a positive impact on improving the quality of education in Pangandaran, particularly in the field of mathematics.

One indicator of the success of this training program is the improvement in teachers' ability to develop technology-based learning media tailored to students' needs, including their learning styles, using the Android-based Kodular application that is suitable for teaching. Based on Figure 8, it can

be seen that the majority of teachers have been able to develop learning media using Kodular. This indicates that, compared to the data from the initial observation (needs analysis), teachers' ability to use Kodular technology as a learning aid has improved. The feasibility of the learning media developed by the teachers was validated by the coach who delivered the material and provided guidance during the training. The validator is responsible for assessing the media's feasibility based on relevant criteria, such as the alignment of the material with learning objectives, technology integration, and the media's ability to support students' diverse learning styles.

Figure 9. Examples of suitable android learning media from TeknoMatika training

The in Figure 9 is an example of a technology-based learning media successfully developed by teachers in the TeknoMatika training program. This learning media was designed using the Kodular application and has met the feasibility criteria set by the validator. The feasibility of this media includes alignment of the content with the learning objectives, and its relevance to various student learning styles, as the material is presented in diverse formats. For instance, content presented in the form of comics, which include images, colors, and engaging illustrations, is given to students with a visual learning style. Content presented in multimedia form, primarily containing audio elements and dialogue in an audio format explaining ratio material, is provided for students with an auditory learning style. Meanwhile, content presented as simulations that involve exploration and hands-on practice is given to students with a kinesthetic learning style.

Discussion

In the preparation phase, 88.2 percent of junior high school mathematics teachers in Pangandaran Regency expressed the need for technology-based training and product differentiation. This finding highlights the urgency of addressing the gap in teachers' skills in utilizing technology to support differentiated learning. This aligns with Chikwaka et al. (2024), who state that the integration of technology in education presents skill challenges among teachers. This gap affects the suboptimal use of learning media that caters to students' diverse learning styles. Furthermore, teachers who are proficient in operating technology and integrating it into teaching can improve the effectiveness of differentiated learning. This statement aligns with Rahman et al. (2019), which shows an increase in student motivation through the use of technology in teaching. This results in enhanced student engagement and greater teacher creativity in designing more relevant lessons.

In the socialization phase, 80.64 percent of the teachers showed a high interest in participating in the TeknoMatika training. This indicates that the majority of teachers are ready and eager to integrate technology into their teaching. The high level of interest in technology among teachers, which reflects their readiness to adopt it, aligns with the views of Arochman & Fortinasari (2024) and Putratama et al. (2023), who state that teachers' readiness to adopt technology is strongly influenced by factors such as access to technology, relevant training, and institutional support. Arochman & Fortinasari (2024) emphasize that teachers who are highly prepared to use technology will be more effective in integrating it into their teaching processes. Furthermore, Putratama et al. (2023) found that training focused on technology skills significantly boosts teachers' motivation to use technology in teaching. Both perspectives support the results from the TeknoMatika socialization phase, where teachers showed high enthusiasm because they recognized the direct benefits of technology in facilitating more interactive and student-centered learning.

During the training, teachers were taught how to identify students' learning styles and develop technology-based learning media, particularly using Kodular to create educational applications. This training strengthens the concept of differentiated learning and targets the improvement of students' learning experiences. This is supported by the opinion of Nurjanah & Suprihatin (2023), who state that Android-based applications developed through Kodular can enhance student engagement in learning, thus improving overall learning outcomes. This indicates that the TeknoMatika training has a direct impact on improving teachers' competencies in creating interactive and personalized learning media. The training also provides a solid foundation for introducing modern teaching methods that are relevant to the digital age.

In the training evaluation phase, despite technical issues, the majority of participants acknowledged the relevance and benefits of the material presented. This reflects the need for improved technological infrastructure to support the smooth running of future training programs, as emphasized by Zananda & Fadli (2024), who note that technology plays a crucial role in creating a positive learning environment. This evaluation also contributes significantly to designing more in-depth and specific future training programs based on teachers' needs, where long-term evaluations can assess the real impact of technology implementation on improving student learning outcomes.

Overall, the TeknoMatika training had a positive impact on enhancing teachers' skills in utilizing technology and developing learning media that cater to students' learning styles. This program has the potential to make a significant contribution to the development of innovation in technology-based mathematics education at the junior high school level. The benefits are not only felt by teachers but also by students through increased motivation, creativity, and understanding of the material.

This training has the potential to become a model for developing teacher competencies in other regions by integrating technology and differentiated learning approaches. The program can serve as a reference for community service in education, particularly in supporting technology-based innovations for more inclusive and adaptive learning. With long-term evaluation and continued mentoring programs, this innovation can continue to develop and provide sustainable impact for the future of education.

4. CONCLUSION AND RECOMMENDATIONS

The TeknoMatika training conducted for junior high school mathematics teachers in Pangandaran Regency has made a significant contribution in enhancing teachers' competencies through the utilization of Kodular technology as a tool to develop interactive Android-based learning media that is relevant to students' learning styles. The novelty of this program lies in the integration of Kodular technology to support differentiated learning, with a focus on leveraging local potential in Pangandaran Regency as part of the learning process. This program offers several advantages compared to other programs, including the use of Kodular technology that helps teachers create Android-based learning media without requiring deep programming skills, and it can be tailored to suit various student learning styles. The positive impact or benefit of this program is that the competencies of junior high school mathematics teachers across Pangandaran Regency have improved in developing learning media using Kodular that is customized to each student's learning style.

For the next community service program, it is important to ensure better infrastructure support, such as a stable internet connection, to address the technical challenges encountered during the training. Further training should also be designed to be more specific and in-depth, for example, by adding more hands-on sessions and providing post-training support for teachers to ensure sustainable technology implementation. Long-term evaluations should also be conducted to assess the impact of technology implementation on student learning more comprehensively. Future community service providers may consider developing more varied training materials, covering not only app creation but also the use of other technologies relevant to the educational needs of this digital era.

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