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COMMUNITY SERVICE: THE TRANSFORMATION OF BADMINTON LEARNING THROUGH VIRTUAL REALITY TECHNOLOGY IN ELEMENTARY SCHOOLS

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Abstrak

Kegiatan pengabdian kepada masyarakat (PkM) bertujuan memperkenalkan teknologi 3D Virtual Reality sebagai inovasi pembelajaran bulutangkis di SD Negeri 168 Pekanbaru. Tahapan kegiatan dalam pelaksanaan program PkM ini terdiri dari beberapa tahap utama, yaitu persiapan, pelaksanaan, evaluasi, serta evaluasi pelaksanaan dan keberlanjutan program. Hasil kegaitan ini menegaskan bahwa pembelajaran menggunakan teknologi 3D Virtual Reality memberikan dampak positif yang signifikan dalam meningkatkan pengetahuan, keterampilan, dan sikap siswa. Teknologi ini terbukti efektif tidak hanya dalam meningkatkan pemahaman teoretis, tetapi juga dalam mengembangkan keterampilan praktis dan membangun motivasi yang lebih tinggi. Kegiatan PkM ini telah berhasil mencapai tujuan utama, yaitu meningkatkan minat dan keterlibatan siswa dalam olahraga bulutangkis melalui pemanfaatan teknologi 3D Virtual Reality (VR). Hasil evaluasi menunjukkan adanya peningkatan signifikan pada aspek pengetahuan kognitif, keterampilan psikomotorik, dan sikap afektif siswa setelah mengikuti pembelajaran berbasis teknologi ini. Meskipun demikian, keberhasilan program ini juga diiringi dengan tantangan, terutama kebutuhan akan pelatihan guru dalam penggunaan teknologi VR untuk memastikan keberlanjutan program di masa depan.

***Kata Kunci**: Teknologi Pendidikan; Virtual Reality; Bulutangkis; Sekolah Dasar; Inovasi Pembelajaran.*

Abstract

The community service activity aims to introduce 3D Virtual Reality technology as an innovation in badminton learning at SD Negeri 168 Pekanbaru. The activity stages in the implementation of this PkM program consist of several main stages, namely preparation, implementation, evaluation, and evaluation of the implementation and sustainability of the program. The results of this activity confirm that learning using 3D virtual reality technology has a significant positive impact on improving students' knowledge, skills, and attitudes. The technology proved effective not only in improving theoretical understanding but also in developing practical skills and building higher motivation. This community service activity has successfully achieved the main objective, which is to increase students' interest and involvement in badminton through the use of 3D Virtual Reality (VR) technology. The evaluation results showed a significant increase in the aspects of cognitive knowledge, psychomotor skills, and affective attitudes of students after participating in this technology-based learning. Nevertheless, the success of this

program is also accompanied by challenges, especially the need for teacher training in the use of VR technology to ensure the sustainability of the program in the future.

Keywords: Educational Technology; Virtual Reality; Badminton; Elementary School; Learning Innovation.

INTRODUCTION

Innovations in physical education learning have become an urgent need to increase students' engagement and interest in sports. One of the approaches that is starting to be widely applied is the integration of technology in sports teaching (Gazali et al., 2024; Perdima et al., 2022), such as the use of Virtual Reality (VR) technology in badminton learning. This technology provides a more interactive and immersive learning experience, which has been proven to increase student motivation and engagement (Arini, 2023). However, the reality on the ground shows that most elementary schools in Indonesia, including SD Negeri 168 Pekanbaru, still face various obstacles in implementing this kind of learning innovation.

Based on observations and interviews with school principals, it is known that students' interest in badminton is low (Raibowo et al., 2024), with many students lacking enthusiasm and even tending to avoid these activities (Hamzah, 2022; Ospankulov et al., 2023). This challenge is exacerbated by the lack of proper space and equipment negatively impacting students' participation and potential in sports (Cahyati & Hariyanto, 2019; Saleh & Ramdhani, 2020), as well as teaching methods that are still conventional (Li & Li, 2024; Pratama et al., 2023). The gap between the potential benefits of using VR technology and traditional learning conditions is a major concern in efforts to improve the quality of physical education in schools. Therefore, concrete steps are needed through training or workshops to introduce VR technology as an innovation in badminton learning to improve student engagement and learning experience as a whole.

Innovative approaches such as the use of technology can be a solution in dealing with these problems. VR technology is now opening up new opportunities in sports learning by presenting realistic simulations that can increase motivation (Gulec et al., 2023; Paramita et al., 2024), increasing the didactic, collaborative, and perceptual components that are important in sports education (Geisen et al., 2023), increasing their enthusiasm (Li & Li, 2024) and their involvement in sports (Mouatt et al., 2020). The application of VR can also provide a more interesting and interactive learning experience (Wu, 2024; Z. Zhang, 2024), so it is believed that it can increase students' motivation in learning badminton. Through VR, students can also experience realistic game simulations (Chover et al., 2022), and gain a better understanding of the basic techniques of badminton (Lee et al., 2020). In addition, VR applications in badminton go beyond training to improve the perception of the sport through environmental factors and emotional experiences, which shows the

diverse benefits and applications of VR in advancing the sport (Dai & Shi, 2022; Wang et al., 2023).

This VR technology approach has been widely applied by lecturers in community service activities in schools. For example, providing VR training for school branding in the digital era (Buana et al., 2024), implementing VR for immersive learning (Ernawati et al., 2024; Suryati et al., 2025), developed and provided web-VR trip supplementation to three corners as a media for promoting school tourism (Erni & Supriyanto, 2023). However, no one has introduced VR technology as an innovation in sports learning in schools, especially badminton. Therefore, the innovation of introducing 3D VR technology in badminton learning offers a significant novelty by presenting a more immersive, interactive, and fun learning experience for students. The application of this technology not only aims to improve students' motivation and skills, but also becomes a breakthrough that can be widely adopted in the technology-based sports education system, making a real contribution to the development of 21st century learning.

This community service activity has a high urgency to be carried out, in line with various studies that highlight the great benefits of Virtual Reality (VR) technology in the field of sports, especially sports learning (Neumann et al., 2018). Studies show that VR provides an immersive and personalized learning environment, capable of equaling or even surpassing the intensity of conventional training (Kuleva, 2023). In addition, VR has proven to be effective in increasing student engagement, motivation, and skill mastery (Kuleva, 2024). VR technology has features such as perception, presence, interactivity, and autonomy that make it a relevant and beneficial tool for physical education teaching and training (Zhang & Liu, 2016). Furthermore, VR can contribute significantly to improving decision-making and prediction abilities in the context of sports education and training (Putranto et al., 2022). This potential is amplified by its ability to facilitate collaborative and perceptual training, which is increasingly relevant in the development of sports skills (Geisen et al., 2023). With comprehensive benefits, the use of VR as an innovation in sports learning needs to be introduced more widely through structured and applicable community service activities.

This community service activity aims to introduce 3D Virtual Reality technology as an innovation in badminton learning at SD Negeri 168 Pekanbaru. This activity supports the Independent Learning Independent Campus (MBKM) program, especially through the Teaching Campus Program, which provides students with the opportunity to be directly involved in the educational process outside the campus. In addition to improving the quality of learning in higher education, this community service activity plays a role in the achievement of the university's Key Performance Indicators. Students involved are expected to gain practical experience with lecturers at the school, as well as open opportunities for internship activities or Field Experience Practice.

MATERIALS AND METHODS

The stages of activities in the implementation of the community service program at SD Negeri 168 Pekanbaru consist of several main stages, namely preparation, implementation, evaluation, and evaluation of the implementation and sustainability of the program. At the preparation stage, the Community Service Team involving two students, Rapindo and Sukaredo, made various preparations for the needs of the activity. The preparations include coordination meetings, the provision of office stationery, the preparation of Virtual Reality (VR) technology equipment and badminton equipment, as well as the preparation of activity schedules.

The implementation stage is the core of the program, where the designed solution is implemented by a team consisting of Novri Gazali, S.Pd., M.Pd., Romi Cendra, S.Pd., M.Pd., Dr. Ahmad Rahmadani, S.Pd., M.Pd., and Dea Mustika, S.Pd., M.Pd. Implementation activities include data collection through pre-test and post-test, the introduction of 3D Virtual Reality technology as an innovation in badminton learning, as well as the practice of using VR to improve student experience in badminton. The evaluation instruments used for the pre-test and post-test are in the form of questionnaires on student involvement and interest in badminton learning, which are adapted from instruments that have been validated in previous research (Kuokkanen et al., 2022). The score of this instrument was measured using the Likert scale with five levels of response, while skill mastery was assessed through direct observation and the standard assessment rubric of badminton basic skills.

The community service participant consisted of grade 5 students who were selected purposively because they were considered to have an adequate motor understanding basis to follow VR technology-based learning, as well as being in a stage of cognitive development that allows them to understand complex instructions related to the use of VR devices. The selection of this sample is expected to provide representative results to measure the effectiveness of learning innovations at the elementary school level. Implications of this sample selection include increased active engagement of more cognitively mature students, which may affect the generalization of outcomes to other age groups.

The evaluation stage is an important part of assessing the effectiveness of activities. The evaluation was carried out by measuring the results of the post-test, analyzing the obstacles that emerged, assessing the benefits of the activity for participants and implementers, and preparing a draft of mandatory and additional outputs in accordance with the PkM program, including the final report of the activity. Furthermore, evaluation of the implementation and sustainability of the program is carried out to ensure the long-term impact of the activities. The sustainability plan observed after two weeks of implementation includes

observation of students' activities in play and sports, as well as their learning activities. This aims to ensure that the innovations introduced continue to provide benefits to students and the school community in technology-based sports learning.

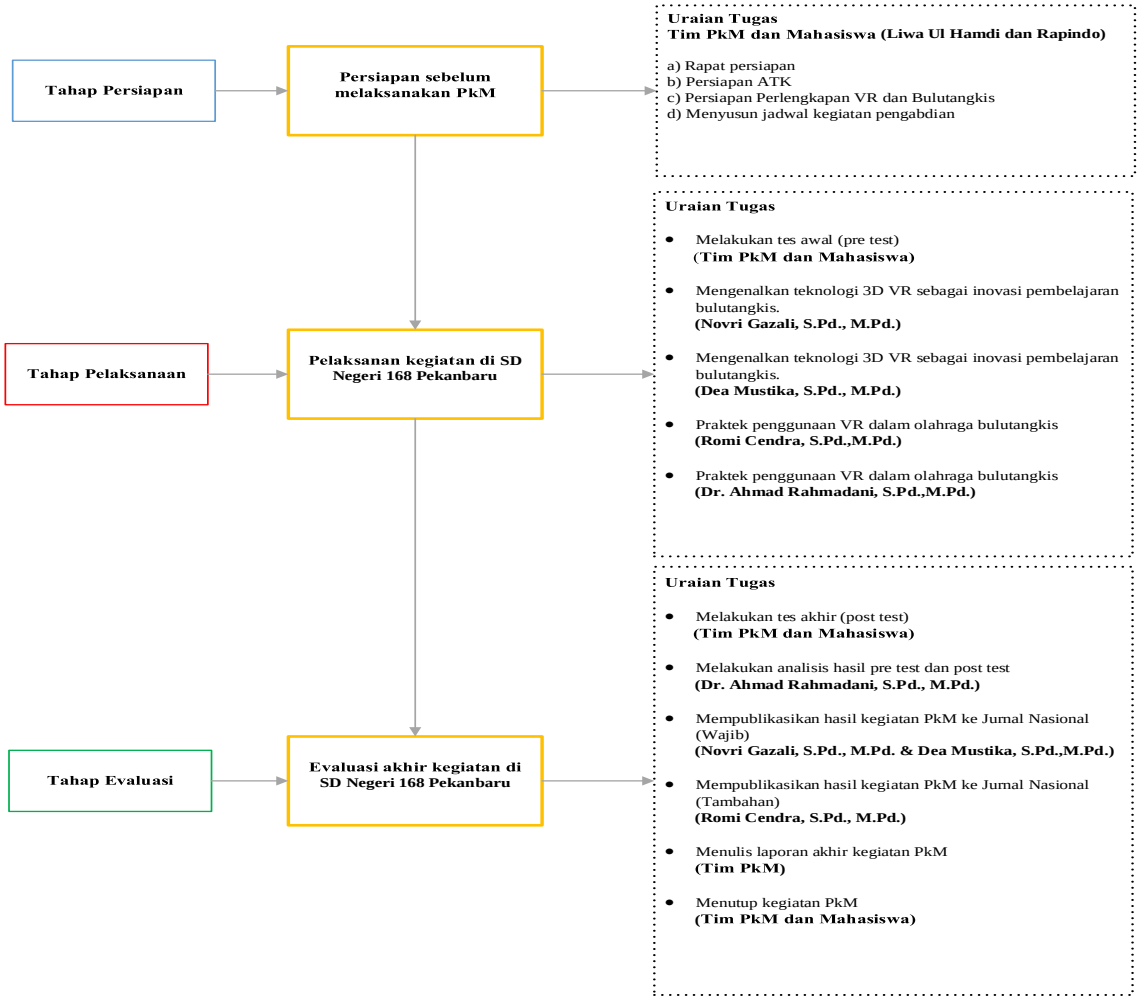

Figure 1. Diagram of the Stages of Community Service Activities

RESULTS AND DISCUSSION

The results of the Community Service activity which was held on November 23, 2024 at SD Negeri 168 Pekanbaru showed various findings that supported the program's goal of increasing students' interest and involvement in badminton through the application of Virtual Reality (VR) technology. A total of 25 grade 5 students participated in learning designed with an interactive and technology-based approach.

In the implementation stage, students start by taking a pre-test session designed to measure three important aspects: their knowledge, skills, and attitudes towards badminton learning before the intervention using Virtual Reality (VR) technology. This initial test includes a series of theoretical and practical evaluations, which are divided into three categories with a predetermined

maximum score for each aspect: (i) Cognitive Knowledge: This assessment involves written questions to test students' understanding of basic techniques, rules of the game, and badminton strategy. (ii) Psychomotor Skills: This evaluation includes a demonstration of physical skills, including the ability to perform serves, forehand shots, and footwork appropriately. The assessment was carried out based on the accuracy and smoothness of the movements. (iii) Affective Attitudes: Students' attitudes are measured through questionnaires designed to assess interest, motivation, and engagement in badminton lessons, using a Likert scale that measures the level of agreement with certain statements related to learning experiences.

The implementation of the pre-test aims to obtain a comprehensive picture of the student's initial condition, which is then compared with the results of the VR intervention to assess the improvement and impact on badminton learning in Figure 2.

Figure 2. Pre-test for Community Service Activities

The next activity is to introduce VR to students and practice its use in improving the badminton learning experience in Figure 3. Students are provided with an explanation of the components of VR technology, including headsets, controllers, and software designed specifically for sports simulations. The service team explained the benefits of VR in creating a realistic and interactive learning environment, which can help students understand the concept of space and movement in badminton more intuitively. After the introductory session, students were divided into small groups to maximize practice time and ensure each participant could experience playing badminton using VR. In this process, students

learn to follow instructions from visual simulations that showcase basic techniques such as serving, forehand punching, and correct footwork.

The practical sessions took place in an enthusiastic atmosphere, with students showing a high interest in trying and learning new techniques. The use of VR provides a very different experience from traditional methods, with a visual feedback feature that helps students correct movement errors in real time. The realistic simulation allows them to better understand hand position, punch angle, and reaction time. In addition, these technology-based activities also facilitate more collaborative learning, where students share experiences with each other and comment on their peers' skills. Teachers involved in this activity noted an increase in student engagement and motivation towards badminton lessons, which were previously considered boring by most participants. Thus, this activity successfully introduces a more interesting and innovative learning approach, opening up new opportunities to improve the quality of sports education through the integration of modern technology.

Figure 3. Introduction and Practice of Using VR

After students were introduced to Virtual Reality (VR) technology and allowed to practice the use of VR in badminton learning, the activity continued with the implementation of the *post-test* in Figure 4. This *post-test* aims to measure changes and improvements that occur in the same three main aspects as *the pre-test*, namely students' knowledge, skills, and attitudes after participating in learning sessions using VR (See Table 2). This *post-test* allows the implementing team to compare data before and after the VR intervention, providing quantitative and qualitative evidence on the effectiveness of VR technology in improving badminton learning in the primary school environment.

Figure 4. Final test (*pre-test*) of Community Service Activities

The results of the comparison between *the pre-test* and *the post-test* showed a significant improvement in all aspects measured in Tables 1 and 2. In the knowledge aspect, the average score increased from 5.2 to 8.7**,** with an increase of 3.5 points, which reflects the improvement of students' understanding of the basic concepts and techniques of badminton after participating in Virtual Reality (VR)-based learning. Psychomotor skills also experienced a sharp improvement, from an average score of 13.8 on the pre-test to 21.4 on the post-test, with a difference of 7.6 points, showing a significant improvement in students' ability to perform basic engineering movements more accurately and effectively. Meanwhile, the average score of affective attitudes increased from 17.4 to 23.1, with a difference of 5.7 points, which indicates an increase in students' motivation, confidence, and enthusiasm in learning badminton.

Table 1. Pre-Test Results of Introduction to 3D Virtual Reality Technology

Measured Aspects	Average Score Pre-Test	Category
Cognitive Knowledge (Maximum Score: 10)	5,2	Quite
Psychomotor Skills (Maximum Score: 25)	13,8	Less
Affective Skill (Maximum Score: 25)	17,4	Quite

Table 2. Post-Test *Results* of Introduction to 3D Virtual Reality Technology

Measured Aspects	Average Score Post-Test	Category
Cognitive Knowledge (Maximum Score: 10)	8,7	Good
Psychomotor Skills (Maximum Score: 25)	21,4	Excellent
Affective Skill (Maximum Score: 25)	23,1	Excellent

The results of this community service activity emphasized that learning using 3D Virtual Reality technology has a significant positive impact in improving students' knowledge, skills, and attitudes. This technology has proven to be effective not only in improving theoretical understanding but also in developing practical skills and building higher motivation (Jiang & Fryer, 2024; Paramita et al., 2024). In sports, VR has been found to improve athletes' engagement and technical skills, with one study reporting a 30% increase in exercise efficiency (Rusmanto et al., 2023).

In addition, students' enthusiasm and motivation to participate in sports also increased, as seen from the high level of engagement during training sessions compared to previous traditional methods. Activity evaluations noted that some students felt more confident in trying new techniques because the simulated experience offered by VR allowed them to learn with a lower risk of injury. This is supported by research showing a strong correlation between VR simulation experiences and increased student satisfaction and confidence (Vihos et al., 2024). This technology also increases students' confidence in trying new techniques and increases their enthusiasm to participate (Kinanti, 2024; Satishkumar et al., 2024). Despite facing challenges such as implementation costs and technical issues, the potential of VR to create immersive interactive learning experiences makes it a promising tool for revolutionizing sports education and training (Kinanti, 2024; Paramita et al., 2024).

The implementation team also noted several challenges, including the need for teacher skill development in utilizing VR technology to ensure the sustainability of the program. In addition to the skill aspect of teachers, another significant challenge is the limitation of supporting infrastructure. The implementation of VR technology requires adequate hardware, such as high-specification computers, VR headsets, and appropriate spaces for safe use. At SD Negeri 168 Pekanbaru, the limitations of supporting devices and facilities can limit the frequency and range of VR use in sports learning.

To overcome this challenge, in addition to advanced training for teachers, investment in improving school facilities and infrastructure is needed. Partnerships with outside parties, such as higher education institutions or private sponsors, can also be a solution to provide technical tools and support. The development of VR-based learning modules that can be easily accessed by teachers will help expand the adoption of this technology despite resource constraints. Follow-up observations for two weeks after the implementation of the program showed that students were more active in sports activities, with an increase in the frequency of playing badminton during breaks. These findings indicate that the application of VR technology as a learning tool can not only overcome the limitations of facilities, but also be effective in fostering students' interest and involvement in sports, especially badminton.

CONCLUSIONS AND SUGGESTIONS

This Community Service activity has succeeded in achieving the main goal, which is to increase students' interest and involvement in badminton through the use of 3D Virtual Reality technology. The results of the evaluation showed that there was a significant improvement in the aspects of cognitive knowledge, psychomotor skills, and affective attitudes of students after participating in this technology-based learning.

It is recommended to hold continuous training for physical education teachers so that they can master the optimal use of Virtual Reality technology. This training is important to ensure the sustainability of the program and support the systematic integration of VR technology in the sports learning curriculum.

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