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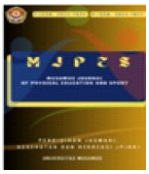

The Effect of Digital Learning Media on Psychomotor Learning Outcomes in Volleyball Underhand Passing among Grade 10 Computer and Network Engineering Students at SMK YWKA Medan, Indonesia

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Abstract
Objectives: This study aims to determine the effect of digital learning media on psychomotor learning outcomes in underhand passing for grade 10 students of the Computer and Network Engineering Department of SMK YWKA Medan.
Materials and Methods: This study used a quantitative approach with a quasi experimental design. The subjects were all 20 grade 10 students of the Computer and Network Engineering Department. The sample of 20 students was divided into two groups: a control group and an experimental group, each consisting of 10 students.
Results: The results showed that the control group, despite not receiving any treatment, experienced an increase in their average score from 59.97 to 67.32 (a 7.35 point increase). Meanwhile, the experimental group, which received treatment using digital learning media in the form of video lessons on underhand passing in volleyball, experienced an increase in their average score from 50.70 to 57.32 (a 6.62 point increase).
Conclusions: The conclusion of this study is that the use of digital learning media in the form of videos on underhand passing techniques has been proven to have a positive impact on improving students' psychomotor learning outcomes in the experimental group. This is demonstrated by the increase in the experimental group's average score from 50.70 in the pre test to 57.32 in the post test. This digital media is effective as a visual clinical intervention tool that helps reduce the percentage of students in the Poor category significantly, namely from 55% to only 15%.
Keywords: Digital Learning; Psychomotor; Underhand Passing.

Introduction

Indonesia's national education system is designed to develop well rounded individuals who are not only intellectually competent but also physically healthy and socially mature. This is emphasized in Law of the Republic of Indonesia No. 20 of 2003 concerning the National Education System, which states that education aims to develop students' potential to become individuals who are faithful, healthy, competent, creative, independent, and responsible. These objectives indicate that physical development and motor skills are equally important as cognitive development. The importance of physical development in education is further reinforced by Law No. 11 of 2022 concerning Sports, which recognizes educational sports as an integral part of the national sports development system aimed at improving physical fitness, skills, and character development. In Physical Education, Sports, and Health (PJOK), learning outcomes are assessed not only through cognitive and affective domains but also through the psychomotor domain. The psychomotor domain relates to students' ability to perform coordinated, accurate, and effective movements according to the techniques being learned.

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According to Simpson's psychomotor taxonomy, as further developed in the context of modern sports education, this domain includes perception, readiness, guided response, mechanism, complex overt response, adaptation, and origination. In sports, psychomotor skills involve movements requiring neuromuscular coordination, rapid responses to stimuli, and systematically trained motor abilities (Winaryo, 2022). In volleyball, psychomotor development plays an essential role, particularly in the basic technique of the forearm pass, which requires body synchronization, hand eye coordination, and movement stability (Sudirman & Hariyanto, 2021). Research by Yusuf and Maulana (2024) indicates that improvements in students' psychomotor abilities contribute directly to the accuracy and quality of passing movements. Furthermore, Putri and Handayani (2025) found a positive correlation between psychomotor coordination and students' forearm passing performance. These findings emphasize that psychomotor development is a fundamental factor in improving forearm passing skills in volleyball learning. The forearm pass is a technique used to receive the ball with both forearms held together. It is an essential skill commonly used to receive serves and defend against opponents' attacks. From a psychomotor perspective, forearm passing requires several physical components, including body posture stability, synchronization of knee and arm movements, control of pushing force, and accuracy in determining the ball's rebound angle.

This is supported by research conducted by Widodo and Haryanto (2021) in the UNY Journal of Sports Science, which demonstrated that forearm passing ability is closely related to arm muscle strength and basic movement coordination. Students with better postural control tend to achieve higher passing accuracy. Furthermore, research by Nasution et al. (2023) in the Journal of Sports and Health Education found that repeated training using structured ball feeds can improve movement stability and consistency in forearm passing among secondary school students. These findings are further supported by recent research conducted by Putri and Anwar (2025) in the Indonesian Journal of Sports Achievement, which demonstrated that the use of video based learning media significantly improves the psychomotor aspects of forearm passing, particularly body positioning and ball rebound direction. Based on these theoretical and empirical findings, it can be concluded that the psychomotor aspects of forearm passing emphasize body stability, synchronization of knee and arm movements, and accuracy in ball direction. The use of visual media combined with structured practice can accelerate students' achievement of the mechanism and complex overt response stages of psychomotor development.

Therefore, the psychomotor learning outcomes of forearm passing in this study can be measured through several indicators, namely basic technical accuracy (arm positioning and ball contact), movement consistency (coordination of knee and arm movements), ball direction accuracy, movement coordination, and body balance. Current developments in digital technology have brought significant transformations to education. The use of digital learning media has increasingly supported teaching and learning activities in schools, particularly at the vocational high school (SMK) level. Vocational high school students are prepared to enter the workforce, requiring learning approaches that are practical, applicable, and adaptable to digital technology. The Merdeka Belajar policy also provides opportunities for innovative learning approaches that accommodate the characteristics and needs of vocational students.

Digital learning media, particularly interactive video based media and dynamic visualizations, enable physical movement materials to be presented through concrete audiovisual content. In learning motor skills such as forearm passing, digital visualization provides strategic advantages for vocational students. Complex movements, including arm positioning, foot stance, and ball contact angles, can be replayed, clarified through

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slow motion features, and analyzed step by step. This provides students with a more accurate understanding of the techniques before performing them on the court, making the processes of imitation and technical internalization more effective and efficient than conventional verbal explanations. By utilizing digital multimedia facilities, teachers can focus more on providing personalized, specific, and corrective feedback to individual students based on available video recordings. This technology based approach creates a more objective evaluation environment and motivates students to improve the precision of their kinesthetic movements. Ultimately, providing digital learning media offers long term benefits that are relevant to the vocational education system, which expects graduates to possess strong independent learning skills.

Encouraging students to engage in self regulated learning through digital media can develop their problem solving abilities when facing difficulties in performing movements. Combining digital instructions with actual motor activities on the court can foster adaptive thinking skills that are essential in the modern industrial era. Thus, providing digital learning support for volleyball forearm passing does not merely improve short term academic achievement but also represents a strategic investment in developing students' technological literacy and self efficacy. However, these ideal conditions have not been fully realized in practice. Based on a preliminary study and an initial volleyball forearm passing skills test (pre test) conducted among 20 tenth grade students in the Computer and Network Engineering (TKJ) program at SMK YWKA Medan, a significant gap was identified between curriculum expectations and students' actual abilities.

The test measured two main aspects of psychomotor performance, namely technical scores (movement execution) and accuracy scores (ball direction outcomes). More specifically, students' technical performance ranged from 26.25 to 41.25, with a class average of only 35.43. These results indicate that most students still experience fundamental difficulties in the mechanism stage of movement, such as maintaining a stable foot stance, keeping their wrists locked, and making proper contact between the ball and the forearm platform. These technical weaknesses directly affect accuracy performance, with students obtaining scores ranging from 15 to 24 and an average accuracy score of 19.70. Inconsistent control of pushing force and inaccurate ball rebound angles cause the ball's trajectory to become uncontrolled and frequently miss the intended target. Overall, the students achieved a class average total score of only 55.13, which remains considerably below the minimum learning mastery standard. The low level of psychomotor achievement is primarily caused by limited face to face practice time on the court and the lack of independent learning resources that students can access outside school hours for self evaluation. To date, PJOK instruction at SMK YWKA Medan has predominantly relied on conventional direct demonstration methods conducted in whole class settings. When teachers demonstrate movements on the court, students with slower visual motor processing abilities often struggle to grasp movement details immediately. Furthermore, the demonstrated movements cannot be reviewed after class because there is no structured video based learning medium available for students to study independently.

Materials and Methods

Study Design

This study employs a quantitative approach using a quasi experimental design. A quantitative approach is used because the study aims to examine the influence of independent variables on a dependent variable through statistical analysis.

Study Participants

The population for this study consists of all tenth grade students in the Computer Engineering and Networking (TKJ) program at SMK YWKA Medan for the 2025/2026

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academic year who are enrolled in Physical Education (PJOK) classes. The sampling technique employed is total sampling, with a relatively small sample size of 20 individuals.

Study Organization

The psychomotor learning outcomes of volleyball forearm passing were assessed using a test consisting of 10 attempts, in which participants stood behind a designated line, received a ball tossed by the researcher, and performed forearm passes toward a target. The assessment covered two aspects: technical performance (60%), including initial stance, arm positioning, ball contact, and movement coordination, and accuracy (40%), measured on a scale of 1–4 based on the ball's proximity to or contact with the target. The final score was calculated by adding the weighted technical and accuracy scores, with a maximum score of 100. The results were classified into five categories: very good (86–100), good (71–85), fair (56–70), poor (41–55), and very poor (≤40). The instrument's content validity was evaluated through expert judgment, while its reliability was tested using Cronbach's Alpha.

Statistical Analysis

Descriptive analysis was used to summarize research data through the calculation of the mean and standard deviation. Before hypothesis testing, prerequisite tests were conducted, including the Kolmogorov–Smirnov normality test to determine whether the data were normally distributed (Sig. > 0.05) and Levene's test to examine variance homogeneity between groups. Hypothesis testing was performed using the Independent Samples t test to determine differences in learning outcomes between the experimental and control groups, with a significance level of 0.05. The null hypothesis (H_0) was rejected if $p < 0.05$ and accepted if $p \geq 0.05$.

Results

This study was conducted to determine the effect of digital learning media on the psychomotor learning outcomes specifically the underhand pass (forearm pass) of 10th grade students in the Computer Engineering and Networking (TKJ) program at SMK YWKA Medan. Psychomotor learning outcomes were assessed by observing students' passing movements, focusing on key criteria: technical precision, movement coordination, passing accuracy, and the consistency of the overall execution. The final assessment score was derived by accumulating the Technical Score (covering initial stance, arm positioning, point of ball contact, and movement coordination) and the Accuracy Score. The study took place between June 25, 2026, and July 13, 2026, involving 20 respondents.

The 20 respondents were divided into two groups: a control group and an experimental group. The control group received no intervention, while the experimental group was provided with an intervention in the form of digital learning media specifically, instructional videos demonstrating the underhand pass in volleyball.

a. A summary of the total scores (Technical Score + Accuracy Score) before and after the intervention is presented in the following descriptive table:

Table 1. Research Results Data

Group	Test	The highest score	Lowest Value
Control	Pre Test	55,75	65,25
	Mean	59,97	
	Post Test	80	57,75
	Mean	67,32	
Experiment	Pre Test	55,5	41,25
	Mean	50,70	
	Post Test	67,25	47,25

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	Mean	57,32

From the table above, it can be seen that the control group despite receiving no intervention experienced an increase in their average score from 59.97 to 67.32 (an increase of 7.35 points). Meanwhile, the experimental group, which received an intervention specifically the use of digital learning media in the form of instructional videos on the underhand pass (passing bawah) technique in volleyball showed an increase in their average score from 50.70 to 57.32 (an increase of 6.62 points).

b. Categorization of Students' Motor Skills

Overall, with a sample size of 20 students, there was a significant shift in the distribution of motor skill categories when comparing the initial state (pre test) with the final state (post test). The changes in the motor skill categories for the underhand pass in volleyball among 10th grade students in the Computer Engineering and Networking (TKJ) department at SMK YWKA Medan are as follows:

Table 2. Changes in Students' Motor Skill Categories

No	Nilai	Category	Pre test frequency	Pre test Percentage	Post test Frequency	Post Test Percentage
1	86–100	Very Good	0	0%	0	0%
2	71–85	Good	0	0%	4	20%
3	56–70	Fair	9	45%	13	65%
4	41–55	Poor	11	55%	3	15%
5	≤40	Very Poor	0	0%	0	0%
Amount			**20**	**100%**	**20**	**100%**

The table above shows that during the pre test, the majority of students 11 in total (55%) fell into the Poor category. Based on the data in Table 5, there was a shift in the students' motor skill categories among 10th grade students in the Computer Engineering and Networking (TKJ) program at SMK YWKA Medan between the pre test and the post test. Can be presented in Figure 1, as follows:

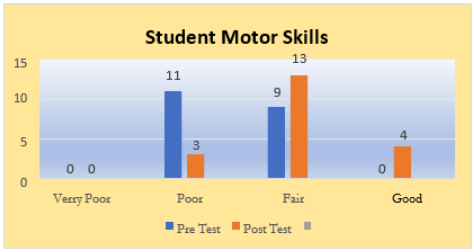

Figure 1. Graph of Changes in Students' Motor Skill Categories

However, following the post test, the number of students in the poor category decreased to 3 (15%). Meanwhile, the fair category saw an increase, rising from 9 students (45%) to 13 students (65%). Furthermore, in terms of cumulative progress, 4 students (20%) successfully reached the good category.

Discussion

Based on the results of the data analysis presented above, a unique finding emerged in this study. In general, both groups experienced improvements in psychomotor learning outcomes in volleyball underhand passing. However, the increase in the mean score of the control group, amounting to 7.35 points, was higher than that of the experimental group, which increased by 6.62 points. This finding requires an in depth analysis from

the perspective of the participants' initial abilities and the dynamics of the motor components being investigated.

The discussion of factors influencing the improvement of students' underhand passing skills is presented as follows:

1. The Influence of Students' Initial Ability Characteristics (Pre test)

Based on the research data, one fundamental finding that influenced the final results was the difference in initial abilities between the two sample groups. From the beginning, the control group had a mean pre test score of 59.70, which was significantly higher than the experimental group's mean pre test score of 50.60. This difference in starting points theoretically and practically provided a mechanical advantage for the control group in adapting their movements throughout the study. Most students in the control group had already developed a better understanding of the fundamental motor components required to perform volleyball underhand passing before the intervention began.

According to motor learning theory, students with higher initial scores tend to be in the associative stage, in which they no longer struggle to understand the movement patterns but instead focus on refining and synchronizing their movements. When the control group received conventional physical training on the court, their previously established muscle memory could be activated and refined more quickly. Repetitive practice without external media distractions allowed them to independently correct minor errors under the direct guidance of the physical education teacher. This explains why their mean post test score increased considerably, reaching 69.65, representing an improvement of 9.95 points.

In contrast, the experimental group began the learning process at the cognitive stage due to their lower initial ability, with a mean score of 50.60. At this stage, most students in the experimental group still experienced fundamental difficulties coordinating their body movements to perform the correct underhand passing technique. The relatively smaller improvement of 6.50 points (from 50.60 to 57.10) indicates that a greater proportion of their treatment period was devoted to developing a basic understanding of movement patterns rather than refining advanced accuracy. Therefore, initial ability (prior knowledge/skills) proved to be a strong predictor of students' final psychomotor performance within the limited duration of the study.

2. The Role of Digital Media in the Motor Abilities of the Experimental Group

Although the overall numerical improvement of the experimental group was lower than that of the control group, the use of digital learning media in the form of instructional videos produced specific improvements in several indicators. Video based learning presented demonstrations of the underhand passing technique visually, repeatedly, and in detail through features such as slow motion. Through this visual stimulation, students in the experimental group, who initially had very low scores, were able to construct a mental blueprint of the correct movement patterns before practicing them directly on the court.

These positive effects were particularly evident in improvements in basic technical skills and accuracy among students who initially experienced considerable motor difficulties. For example, students named Salsabila and Suci I L, who obtained total pre test scores of approximately 41.25 and 44.25, respectively, placing them in the Poor category, managed to improve their performance to 47.25 in the post test. Digital instructional videos provided these students with opportunities to repeatedly observe the correct ball contact position on the forearms and the proper coordination of knee flexion. Such understanding would be difficult to acquire immediately through only a brief, one time demonstration by the teacher on the court.

From a psychomotor perspective, the visual modeling process provided by digital videos stimulates the activity of mirror neurons in students' brains, which function to map

observed movements onto their own motor systems. This process helps reduce students' uncertainty when handling and practicing with an actual volleyball.

The overall decrease in the number of students in the Poor category, from 11 students (55%) in the pre test to only 3 students (15%) in the post test, provides empirical evidence of the contribution of digital media as an instructional intervention, particularly in helping students with slower learning progress (slow learners) improve their fundamental technical skills.

3. A Critical Evaluation of the Characteristics of TKJ Students in Practical Sports Learning

The characteristics of the research participants, who were Grade X students majoring in Computer and Network Engineering (TKJ) at SMK YWKA Medan, provide a distinctive perspective in interpreting the findings of this study. TKJ students generally have greater familiarity, comfort, and literacy in using digital technological devices. When video based learning media were integrated into Physical Education, Sports, and Health (PJOK) lessons, they successfully stimulated students' enthusiasm, focus, and attention because the learning approach was relevant to their everyday experiences with digital devices and multimedia.

However, this high level of digital interest created a paradox in the implementation of practical sports activities. Psychomotor skills, such as volleyball underhand passing, fundamentally require not only a strong cognitive understanding of movement techniques but also actual physical adaptation involving muscle strength, flexibility, reflexes, and repeated physical motor practice (drills) on an outdoor court. TKJ students, who may spend more time engaging in computer based activities associated with a sedentary lifestyle, may experience a gap between their visual understanding of movements presented on a video screen and their actual physical coordination when executing the technique on the court.

This condition logically explains why the control group, which received conventional instruction through direct demonstrations and regular physical practice, achieved greater improvement. In sports learning, direct physical practice, real time corrections from the teacher on the court, and repeated execution of actual movements remain essential components that cannot be fully replaced by any digital screen. Digital learning media should therefore be positioned as a complementary resource or enrichment strategy within a blended learning approach to strengthen students' tactical and technical understanding in the classroom. Nevertheless, conventional physical training and the development of body coordination through direct practice on the court must remain the primary components to achieve optimal psychomotor learning outcomes.

Conclusions

The conclusion of this study is that the use of digital learning media in the form of videos on underhand passing techniques has been proven to have a positive impact on improving students' psychomotor learning outcomes in the experimental group. This is demonstrated by the increase in the experimental group's average score from 50.70 in the pre test to 57.32 in the post test. This digital media is effective as a visual clinical intervention tool that helps reduce the percentage of students in the Poor category significantly, namely from 55% to only 15%.

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Conflict of Interest

The authors declare no conflict of interest.

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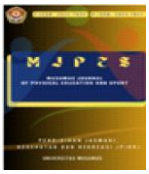

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