Development of an Android-Based Digital Game Instrument for Evaluating Volleyball Serve and Smash Skills

Desarrollo de habilidades de voleibol basadas en modelos de instrumentos digitales

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Abstract

This research aims to develop a digital instrument-based volleyball game skill test tool. Data collection uses observation, questionnaire, interview, and test. The data analysis technique used in this study was quantitative descriptive statistics with the effectiveness test using t-test. The small-scale trials given to 12 subjects had an average value of 78.2% in the category of "good/feasible" to proceed to the large-scale trial phase. The results of the Testing Protocol for Monitoring Spike and Serve Speed in Volleyball are radar sensor-based service and smash tests not based on Android. The renewal of this research is that application software tools have been added to the Android application so that it can be used on an Android smartphone. Therefore, a digital game instrument of volleyball skills is "Eligible" and effective to be used as a tool to measure the technical ability of volleyball players.

Keywords: Sport skill, technical ability, test tool.

Resumen

Esta investigación tiene como objetivo desarrollar una herramienta de prueba de habilidad de juego de voleibol basada en instrumentos digitales. La recopilación de datos utiliza la observación, el cuestionario, la entrevista y la prueba. La técnica de análisis de datos utilizada en este estudio fue la estadística descriptiva cuantitativa con la prueba de efectividad mediante la prueba t. Los ensayos a pequeña escala entregados a 12 sujetos tuvieron un valor promedio de 78,2% en la categoría de "bueno/factible" para pasar a la fase de ensayo a gran escala. Los resultados del Protocolo de prueba para monitorear el remate y la velocidad del servicio en voleibol son pruebas de servicio basadas en sensores de radar y remate que no se basan en Android. La renovación de esta investigación es que se han agregado herramientas de software de aplicación a la aplicación de Android para que pueda usarse en un teléfono inteligente Android. Por lo tanto, un instrumento de juego digital de habilidades de voleibol es "Elegible" y efectivo para ser utilizado como una herramienta para medir la habilidad técnica de los jugadores de voleibol.

Palabras clave: Habilidad deportiva, habilidad técnica, herramienta de prueba.

Introduction

Various sciences must quickly adjust to several demands, one of which is sports science. The speed at which knowledge and technology evolve highlights the importance of good and up-to-date education programs in all professional fields, including sports coaching (Rui et al., 2014). According to Cojocaru and Cojocaru (2018), the volleyball game contains a series of individual technical–tactical actions interacting during the game. Bratovčić et al. (2017) said 12 players participated in the game, six in each team. The game is played in three won sets on the principle of tiebreaks up to 25 points with a difference of 2 points in the first 4 sets, and in the fifth set, a tiebreak is played up to 15 points with a difference of 2 points. According to Luminița and Valentina (2017), volleyball is a loving and exciting sport, but its poor promotion leads to a low number of participants, especially in areas where this sport has no tradition. There are several kinds of basic techniques in volleyball games: service, passing, smash, and block. The basic technique of volleyball, according to the results of the study by Florin and C-Tin (2013), states that volleyball is a complex sport where the results in the game depend on the cooperation of each player who occupies a position following the rules of the game. The performance in volleyball games requires a good psychomotor aspect and is trained on every player. The ability to adapt to a team and physical and psychological abilities influence the outcome of the game. According to Raiola (2014), in the process of learning volleyball, using a tutorial that has a theoretical basis in a cognitive approach that covers the development of strength and skills can be useful. The results of research by García-De-Alcaraz et al. (2017) provide a reference value in guiding the development of athletes and for coaches to be used in evaluating the skills both during matches and volleyball basic technical training. Exercises to improve service below are performed to improve service skill (Destriana et al., 2000).

Research by Luis-del Campo et al. (2022) indicates that probability information from video analysis regarding the opponent's setter passing direction significantly influences the blocking performance of skilled female volleyball players. The study found faster reactions from blocking players when receiving this information but no effect on decision-making and the quality of movement execution. These findings confirm the importance of probability information in enhancing initial responses in volleyball blocking at high skill levels. Similarly, research by Jiménez-Olmedo et al. (2022) on the effects of Deep Dry Needling on latent myofascial trigger points on jumping performance showed moderate increases in jump height after one week of intervention among international beach volleyball players under the age of 21. However, the decrease in performance immediately after the intervention suggests that using this technique just before competition is not recommended. Both studies highlight the importance of using appropriate strategies and interventions to improve volleyball players' performance, considering these interventions' short-term and long-term effects.

According to results of research by Boichuk et al. (2017) and Clemente et al. (2015), modern volleyball is connected with highly intensive loads; stability, distribution, and re-switching of attention; and maximal speed of players' reaction. Moreover, it has also been found that in volleyball matches, better attacks occur at the beginning of the set (first 15 rallies). The spike is the best indicator of success in high-level men's volleyball, but only when considering relative measures. The number of block points per game proved to be a good indicator of success in a match (Přidal & Priklerová, 2018)

Tests are tools or instruments used to obtain information about a person or object (Widiastuti, 2015). To get good measurement results, you should use a test tool or instrument that refers to the purpose of the test itself. Previous research on the development of volleyball service test instruments was conducted by Palao and Valades with the title, Testing Protocol for Monitoring Spike and Serve Speed in Volleyball. The research resulted in the development of two types of test instruments, namely, an instrument to see the strength of a smash and an instrument for service (Palao & Valades, 2009). Furthermore, the results of Hidayat et al. (2019) developed a computer-based volleyball passing test instrument. The research developed a volleyball passing test instrument that uses vibrating sensors and computer-based applications. The result is effective for measuring the volleyball player's skill level. Research Destriana et al. (2020) Development of Overhand Serve Learning Techniques in Volleyball Games.

The development of an Android-based pocketbook application is feasible to use in the learning process (Oktiana, 2015). Satyaputra (2014) stated that Android is an operating system for smartphones and tablets. Furthermore, in the opinion of Huda (2013), Android is a Linux operating system that is made specifically for mobile devices such as smartphones or tablets.

The speed at which knowledge and technology evolve highlights the importance of good and up-to-date education programs in all professional fields, including sports coaching (Rui et al., 2014). Furthermore, according to Vladimir and Marian, "there are connections among digital systems governed by standard devices developed by the International Standards Organization which produce the OSI (Open System Interconnection), model". The physical interconnection model of the OSI reference model shows ways of communicating with data connections, synchronizing communications, correcting errors, network errors, network circuits, display, performance, imaging, and creating digital applications (Vladimir & Marian, 2015).

According to Tangkudung (2016), development research is research that is used to create new products and/or develop existing products, based on an analysis of needs found in the field. According to Ardani (2015) development can be interpreted as a process of translating or describing design specifications into physical features. Science and technology will continue to grow and be utilized in the world of sports because current technological advances are very beneficial for improving sports achievements.

The results of research on the development of the volleyball skill test instrument above and the results of previous studies are in line with the results of the research conducted, namely, by developing a digital-based volleyball skill test instrument. Thus, this study has renewal in terms of components and Android applications that can be used by smartphones and tablets. The product test results are more effective and efficient for measuring volleyball skills.

Materials and Methods

The research approach used in this research is research and development, which are as follows: (1) research and information collecting, (2) planning, (3) developing preliminary product form, (4) preliminary field testing, (5) main product revision, (6) main field testing, (7) operational product revision, (8) operational field testing, (9) final product revision, and (10) dissemination and implementation (Borg & Gall, 2007).

Research Subject

The research subjects were 52 male and female volleyball players aged 14-20 years, 28 male and female volleyball players from the Sriwijaya State Sports School (SONS), and 24 male and female volleyball players from Bina Darma University. The subject's characteristics are volleyball players who actively train and have two years of training experience. A purposive sampling technique was chosen for the research subject.

Data Collection Techniques and Instruments

Data collection techniques in this study were (1) observations of spaciousness where the research subjects were carried out and (2) interviews with trainers. These were followed by data collection instruments using a questionnaire, observation, interview, and volleyball skills test. Test instruments to measure serves and smashes used volleyball serve test instruments and volleyball smash test instruments. The questionnaire can be a closed/open question/statement. According to Sugiyono (2013), the types of questionnaires, according to their shape, are divided into three categories: (1) multiple-choice questionnaire, (2) checklist, and (3) rating scale.

Data Analysis Techniques

Data analysis includes all the activities of clarifying, analyzing, using, and drawing conclusions from all data collected in action, whereas quantitative data were obtained by giving a score qualitatively based on a Likert scale that was converted to a scale value of 4, Table 1.

Table 1
Likert Scale

Scale	Description
1	Very inadequate/good/suitable
2	Not decent/good/suitable
3	Decent/good/suitable
4	Very decent/good/appropriate

A percentage is intended to find out the status of something that is presented as a percentage. The formula for calculating eligibility, according to Sugiyono (2013) is as follows:

Formula: $\frac{SH}{SK}$ *x* 100% (1)

Where, SH: Calculate score; SK: Criteria score or ideal score.

The results of subsequent data calculations are made in the form of a percentage multiplied by 100% and in the four categories of eligibility by using the scale as follows (percentage of eligibility category by Arikunto (2010) (Table 2).

Table 2
Percentage of eligibility

Score as a percentage	Eligibility category
<40%	Not good/not eligible
40–55%	Poor/inadequate
56–75%	Good enough/decent enough
76–100%	Good/decent

Note: (1), strongly disagree/very improper; (2), not appropriate/not feasible; (3), appropriate/feasible; (4), very appropriate/very feasible. After knowing about feasibility data, the data is calculated using nonparametric statistical analysis techniques, namely, data normality test and paired sample t-test. Given an approved value of $p > 0.005$, then H0 is rejected, resulting in a significant difference between the results of manual service tests with digital tests.

Results

A small group trial was conducted on 12 Bina Darma University volleyball players. The test subjects performed all digital-based volleyball skill-testing tests, Table 3.

Table 3
Data on small-scale group trial results

Aspect of rating	Count score	Max score	Percent	Category
Originality	78	96	81.2	Good/ decent
Innovation	114	144	79.2	Good/ decent
Usability	188	240	78.3	Good/ decent
Safety	111	144	76.4	Good/ decent
Use	146	192	76	Good/ decent
Total score	631	816	78.2	Good/ decent

Based on the results of a small-scale trial, as shown in Table 3, in the aspect of originality, the digital-based volleyball skill test instrument scores 81.2% in the "good" category, which means that the digital-based volleyball skill test instrument is "feasible." The excellence aspect of the digital-based volleyball skills tests instrument scores 79.2% in the "good" category, which means that the digital-based volleyball skills test instrument is "feasible." The aspect of the use of digital-based volleyball skills test instrument scores 78.3% in the "good" category, which means that the digital-based volleyball skills test instrument is "feasible." The safety aspect of the digital-based volleyball skills tests instrument scores 76.4% in the "good" category, which means that the digital-based volleyball skill test instrument is "feasible." The excellence aspect of digital-based volleyball skills tests instrument scores 76% in the "good" category, which means that the digital-based volleyball skills test instrument is "feasible." Thus, the average value of the results of small-scale trials is 78.2% in the "good" category, which means that the digital-based volleyball skills test instrument is "feasible."

Large group trials were conducted on 24 male and female volleyball players from Bina Darma University, Table 4. Based on the results of large-scale group trials as shown in Table 4, in the aspect of originality, the digital-based volleyball skills test instrument scores 83.3% in the "good" category, which means that the digital-based volleyball skills test instrument is "feasible." The excellence aspect of the digital-based volleyball skills test instrument scores 84.7% in the "good" category, which means that the digital-based volleyball skills test instrument is "feasible." The aspect of the utilization of digital-based volleyball skills tests instrument scores 87% in the "good" category, which means that the digital-based volleyball skills test instrument is "feasible." The safety aspect of the digital-based volleyball skills tests instrument scores 86.1% in the "good" category, which means that the digital-based volleyball skills test instrument is "feasible." The excellence aspect of the digital-based volleyball skills tests instrument scores 87.5% in the "good" category, which means that the digital-based volleyball skills test instrument is "feasible." Thus, the average value of the results of large-scale group trials is 85.7% in the "good" category, which means that the digital-based volleyball skills test instrument is "feasible."

Table 4
Data from large-scale group trial results

Aspect of rating	Count score	Max score	Percent	Category
Originality	80	96	83.3	Good/ decent
Innovation	122	144	84.7	Good/ decent
Usability	209	240	87	Good/ decent
Safety	124	144	86.1	Good/ decent
Use	146	192	87.5	Good/ decent
Total score	704	816	85.7	Good/ decent

The results of the effectiveness test were carried out using a t-test involving 52 subjects, namely, 24 male and female volleyball players from Bina Darma University and 28 male and female volleyball players from Sriwijaya State Sports School. The following are the results of the t-test for the manual and digital groups (Table 5). Based on the output above, Table 5, the significance value (sig.) for all the data, both Kolmogorov–Smirnov, and Shapiro–Wilk tests > .05, it can be concluded that the study is stated to be normally distributed.

Table 5
Test of Normality Instrument

Test of Normality						
	Kolmogorov–Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Manual	.126	52	.039	.947	52	.022
Digital	.134	52	.020	.948	52	.023

Note: a. Lilliefors Significance Correction.

The following are the results of the t-test for the value of the manual group and the digital group, Table 6.

Table 6
T-Test Results of Experiment Groups and Control Groups

Paired Samples Statistics					
		Mean	*N*	*SD*	*Std. Error Mean*
Pair 1	Manual	21.692	52	5.249	.728
	Digital	22.481	52	5.256	.729

Looking at the data in Table 6, the mean result of the control group was 21.692, and the mean result of the experimental group was 22.481 (in the group statistics table). From these data, it can be seen that the value of the experimental group is higher or greater than the control group, Table 7.

Table 7
Paired simples instrument tests

Paired samples test									
		Paired differences					T	df	Sig. (t
	$\bar{x}$	*SD*	*σM*	*95% CI*					
					Lower	Upper			
Pair 1	Manual – Digital	−.941	.238	.033	−1.008	−.874	−28.284	50	.000

In the results of the paired samples test output above, the value of t =−11.406 and Sig. (two-tailed) or *p*-value = .000 < .05 or Ho is rejected. There is then a significant difference between the results of manual service tests and digital tests. The difference between the average control group (21.692) and the average of the experimental group (22.481) was revealed. This shows that the increase in the experimental group was higher than the control group, which means that digital-based volleyball skills instrument models are more effective for conducting volleyball smash skills tests.

Discussion

This developmental research aims to provide a new alternative in evaluating the skills of volleyball game techniques, which are more varied and effective. The product developed is a digital-based volleyball skill test kit, where researchers utilize digital technology as the main component to make this test kit. The technology used is the latest development both in software and hardware, to produce a good and appropriate product used to measure volleyball game skills.

Meanwhile, the results of research by Manafifard et al. (2017) stated that the purpose of player tracking technology is to find out the extent of the movements made by players, mark players, and find out how players look. Research results by Thomas et al. (2017) are in line with the results of research that most sports can use sensors or other devices to monitor players while other equipment is not possible.

This development research uses a model of developing preexisting tools such as a test and smash test based on technology. From the instrument model, the researchers then developed it in a form and innovation that was certainly different from previous research, both of the physical aspects/components and software that is made. In terms of physical/component aspects, if in previous studies conducted by Hidayat et al. (2019) the components were made of one type of vibrating sensor and one sensor used in volleyball fitting test, in this study, in one the circumference of the target, there are four sensors installed so that the level of sensitivity will be better than the previous studies. Furthermore, for volleyball smash tests, previous studies conducted by Palao and Valades (2012) only looked at how fast the smash shots were carried out by volleyball players, using camera radar as a detector, in contrast to the development carried out in this study. This research makes smash test kits that apply to volleyball games of the same size where players smash exactly at the time of the game. Therefore, the test equipment is made following the area of half the volleyball court where the test equipment is placed and then given numbers as a target. Based on several different elements both in terms of physical/component and software aspects, of course, the research on the development of a volleyball skills test is an innovation, and the original has not been done by other researchers. Besides, this product will be very helpful in carrying out volleyball skills tests for beginner athletes as well as students and the general public. This product has utilized digital technology so that very new and more objective data are generated. Thus, the data cannot be changed by athletes to minimize data manipulation actions. Obviously, with an objective result, the coach or teacher will know the actual skill level of each athlete or student.

Conclusions

Based on the results of data analysis obtained from several good stages of expert validity test, proceeding with small-scale group trials and large-scale group trials obtained average scores as follows: Stages of expert validation given by five stages I experts following their respective expertise obtained an average rating of 72.4% in the “good enough” category, which means that the digital-based volleyball skills test instrument was “decent enough.” Furthermore, the stage II validation expert test from five experts obtained an average rating of 84.1% in the “good” category, which means that the digital-based volleyball skills test instrument was “eligible” to be continued in the next stage, namely, the product trial phase. Furthermore, the small-scale group trial phase obtained an average score of 78.2% in the “good” category, which means that the digital-based volleyball skills test instrument was “feasible” to proceed to the large-scale trial phase. The average value of the results of large-scale group trials is 85.7% in the “good” category, which means that a digital-based volleyball skills test instrument is “feasible” to measure volleyball skill testing. In the results of the independent samples test output above, the value of t = −11.406 and Sig. (two-tailed) or *p*-value = .000 < .05 or H0 is rejected. There is then a significant difference between the results of manual tests and digital tests. Thus, it can be concluded that the digital-based volleyball skills test instrument is effective and feasible to measure volleyball skills tests.

The results of this study are expected to contribute to sports education, especially in volleyball games. With the presence of digital-based instruments, it is expected to provide examples of instruments that are more specific to sports education. In the future, researchers want to carry out research that has a better effect on sports education.

Conflict of Interest Statement

The authors declare that there is no conflict of interest.

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Authors’ Contribution

Conceptualization, M. and D.; Methodology, M. and D.; Validation, A.F.; Formal Analysis, A.F.; Investigation, M., D., and A.F.; Data Curation, A.F.; Writing – Original Draft, M., and D.; Visualization, M., and D.; Supervision, M., and D.

Data Availability Statement

The data that support the findings of this study are available on request from the corresponding author (muslimin@binadarma.ac.id).

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