Smart Analysis (Speed Movement Acceleration Reaction Time) Based on Windows Applications for Increasing the Effectiveness of Volleyball Athletes' Spikes

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Abstract

This study aims to develop motion analysis using kinovea software. The research method used is research and development of the ADDIE model, which consists of 5 stages, namely (1) analysis, (2) design, (3) development, (4) implementation, (5) evaluation. The sample used was 30 students of the STKIP Muhammadiyah Kuningan volleyball student activity unit (UKM). The results showed that this training model was valid, practical, and effective. Validity: expert judgment for the material score is 3.95, and expert judgment media produces an average score of 3.95, both in the valid category. Practical: the average response to the small-scale questionnaire was 3.71 (good), the average response to the small group trial questionnaire was 3.84 (good), and the average response to the field trial questionnaire was 3.51 (good). Effectiveness: n-gain test value 0.56 (medium). It can be concluded that the application of the Kinovea software to analyze the basic spike technique in volleyball has a significant contribution.

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INTRODUCTION

The world of sports cannot be separated from science and technology to achieve the highest achievement. Therefore, science and technology must be appropriately applied. The use of IT will improve the quality of human resources, especially in strategic sectors. The development of sports science and technology has been confirmed in Law no. 3 of 2005 concerning the National Sports System, particularly Article 74 (UUSKN, 2005). Furthermore, it is further clarified in PP No. 16 of 2007, especially in Chapter IX Article 74 (Government Regulation No. 16, 2007).

Athletes and coaches urgently need this study with a strategic issue raised, namely the limited human resources of sports practitioners to minimize the accumulation of lactic acid to prevent fatigue in athletes. Implementation is carried out through research at several schools

in Kuningan Regency that have volleyball athletes (Arif & Sujarwo, 2021). Based on observations made by researchers, it was found that 1) to support the achievement of sports achievements in Kuningan, it is necessary to improve the quality of human resources who master IT, 2) Volleyball coaches in Kuningan Regency in particular and in West Java, in general, need to optimize the role of windows application technology (Kinovea).) to analyze the biomechanics of motion to prevent spike errors in athletes, 3) there is a need for technological analysis on the spike movement of IT-based athletes, in this study, more focus on IT-based SMART analysis, which so far is still manual.

The problem to be researched is that it is necessary to analyze the spike movement analysis of volleyball athletes based on windows application (Kinovea), which is still manual.

The specific purpose of conducting in-depth research on the SMART analysis of volleyball athletes based on windows application (Kinovea). This research is fundamental (urgent) because athletes often experience errors when spiking volleyball which causes inaccuracies, making it difficult to achieve and develop their game. So it needs to be supported by windows application (Kinovea).

Kinesiology is knowledge related to body movement and sports that use motion mechanics (Knudson Duane, 2007). The discipline of biomechanics is an applied science supported by other sub-disciplines,

such as anatomy, physiology/physiology, and physics. These three sub-disciplines form the basis for the development of biomechanics disciplines (Hidayat, 2013; Sinurat & Tofikin, 2021). The main emphasis in biomechanics is the concept of human motion mechanics in improving performance in sports achievements. Menrut Qomariyah, M. T., & Herdyanto (2019). Biomechanics is a science that studies the motion of the human body with the principles of mechanics. The development of technology, the concept of biomechanics in sports, makes it easier for athletes.

Motion is a significant factor in every vital sporting activity. SMART (Speed Movement Acceleration Reaction Time) motion in the form of body movements or motion of objects or tools resulting from the bodywork. Motion is a function of speed and direction. SMART (Speed Movement Acceleration Reaction Time) motion can be horizontal or vertical. The focus is horizontal or vertical or makes an angle with the flat or circular motion around the circle's centre.

Speed is a change in the position of objects in units of time (Habibie et al., 2020; Hidayat & Iskandar, 2019). Acceleration is the increase in speed in unit time. According to Dwi (2018), speed is moving places in a short duration of time.

Relevant theories in the development of motion science to support research can be used as reference points. We need to understand the idea of motion well from various literature to enrich the terminology from experts so that it can help explain the application of sports

activities such as running, jumping, throwing, gymnastics, big ball sports, small ball games, agility sports, and other sports (Dwiyanti et al., 2020).

Based on the explanations of the theories that have been presented, it can help to analyze movements such as spike speed in volleyball games, the position of the feet in a state of floating in the air (not in contact with the ground) and when in connection with the environment, SMART (Speed Movement Acceleration Reaction) movements. Time) turning and some aspects and techniques in sports and human activity.

In improving a movement, from the perspective of mechanics, we can analyze quantitatively, but to add a comprehensive understanding, we need to know qualitative analysis. Data that is quantitative and qualitative from the athlete's performance is analyzed by coaches, teachers, or doctors to get the best performance. Athletes' performances, measured using a quantitative approach, get results in numbers or numbers, while the athlete's performances measured by observation are qualitative approaches. Both data in the form of numbers and words need to be supported by relevant theories so that the findings of the measurement results can be scientifically justified.

Biomechanical analysis through a quantitative approach to movement identification with SMART (Speed Movement Acceleration Reaction Time) (Saputro et al., 2020), namely active muscle groups in every movement performed at a particular phase, is called quantitative anatomical analysis (Rusdiana., 2020). The skills of an activity can be said to be simple or complex depending on the qualitative anatomical analysis that will be focused on. One example of a complex skill is the number of sprints in the starting technique. If we compare fast, slow, high, low, long, short, large, small, and so on, it can illustrate these characteristics. Using observation or observation to obtain data from skill is a qualitative analysis.

Biomechanics is a science that discusses the internal and external forces of the human body's performance and the consequences of the resulting forces (Asmara., 2020). Peter M. Mc Ginnis (2005) explains the notion of biomechanics as a field of science that studies the structure and biological systems in terms of mechanical methods.

A volleyball game is a dynamic game carried out by applying several relevant technical factors according to the situation needed to get maximum results. Spike is a shot that is launched when the hand is in complete contact with the ball at the top so that the ball flows quickly and sharply towards the opponent's area that is difficult to reach. Spike is usually done by a spiker with a sharp stroke specialist and is ideal for volleyball players.

Spike is a form of attack with various variations and combinations of players to obtain points in the game. From some of the opinions above, it can be concluded that the smash or spike technique is a way to play the ball efficiently and effectively by the rules of the game to achieve a hard hit that is usually

deadly to the opponent's area. According to Beutelstah (2015), Spike is an essential skill, the easiest way to win points. A player who is good at spikes, or in a foreign term called "smasher", must have the agility and be good at jumping and have the ability to hit the ball as hard as possible. According to Nasution (2015), Spike is an attack technique carried out against the opposing party. Spike has the characteristics of the ball dropping sharply in the opponent's area or target point. Spike is one of the basic skills a volleyball player or athlete possesses.

A practical and maximum spike will result in a number and psychologically make the opponent's mentality fall. The ability of the spiker the correct height of the bait ball are the factors that support the spike results. Spikes that are carried out with the right, systematic, efficient and effective technique affect accurate results to reach numbers. Biomechanics is a science implemented in sports to analyze human body movements (Syaukani et al., 2020). The spike technique in volleyball is a movement carried out quickly and accurately in a relatively short time. Strategies to take advantage of opportunities when spiking by setting fewer initial moves. Using the prefix 3 times in each game will reduce the speed of movement and power so that it is easy to block the opponent (Santoso & Irwanto, 2018).

METHODS

The method used in this research is Research and Development (Robert Maribe Branch, 2009; Ramadan & Juniarti, 2020),

known as ADDIE, which involves the stages of model development with five steps/development phases Analysis, Design, Development, Implementation and Evaluations).

The research was conducted from January to December 2021 in Kuningan Regency, West Java Province. The research subjects were extracurricular students and trainers. The research instrument used a questionnaire and a volleyball spike test. Data analysis techniques were carried out with qualitative and quantitative approaches. The research instrument used a questionnaire and a volleyball spike test. The data analysis technique was carried out using a qualitative and quantitative approach. Qualitative in the form of the results of the analysis of opinions, input and suggestions from experts, while quantitative in the form of a percentage (%) of the coach's view on the fatigue level of their athletes.

It is hoped that the research carried out will run smoothly, so the duties of the chairperson and members of the research team are described as follows: The task of the research team leader is to lead research starting from planning, implementing activities, reporting on final results, publishing scientific articles and registering a copyright, while the duties of members of the research team namely 1) assisting the chairman in searching for the latest references for the past 10 years, 2) compiling needs analysis, 3) searching for data, administering research results, analyzing data, formulating articles,

managing the publication of scientific articles, compiling reports on the implementation of activities, and compiling final reports.

FINDINGS AND DISCUSSION

Findings

The research results carried out are related to the use of the kinovea application in analyzing the basic volleyball spike technique using the Research and Development method with the ADDIE pattern. The stages of the research are as follows: 1. Analysis. Based on the observations made by researchers, there are; a) To minimize the error rate of athletes in volleyball spikes and sports practitioners need to understand biomechanical motion analysis before competing, b) to support the achievement of athletes, it is necessary to improve the quality of human resources who master IT, c) there is a need for technological analysis on the physical condition of athletes, in this study focused on SMART (Speed Movement Acceleration Reaction Time) analysis before spike volleyball based on windows application (kinovea) which so far is still manual. Analysis of the problems found is that the spike movement of the STKIP Muhammadiyah Kuningan volleyball athletes

still has not reached maximum accuracy. 2. Design. The product developed in this research is a motion analysis in performing the basic volleyball spike technique using the windows application kinovea. From this analysis, we can find several factors in it, which will then be analyzed using the kinovea application to measure the biomechanics aspects to be streamlined. 3. Development. The development process is carried out in stages. To produce a proper and quality motion analysis, material expert validation, media expert validation, small-scale trials, medium-scale trials, field trials, and model effectiveness tests are carried out. These processes are intended to obtain media quality data in terms of validity, practicality, and effectiveness of subsequent revisions or improvements to achieve a proper, quality and valuable analysis tool for its users. After the teaching aid process is complete, a review is carried out by an expert who will assess the validity of the teaching aids (i.e. material experts and media experts). Each expert fills out a validation questionnaire compiled based on predetermined aspects. Data from media questionnaires by biomechanics material experts are presented in Table 1.

Table 1. The result of material experts

Aspect	Average Value	Criteria
Quality of content and purpose	3,95	Good
Training quality	3,92	Good
Analysis design	3,97	Good
Average	3,95	Good
Validity	3,95	Valid

Based on table 1, it can be explained that the assessment carried out by biomechanics material

experts on the quality of content and objectives using a Likert scale 1-5 obtained a score of 3.95,

the quality of exercise received a score of 3.92. Design analysis received a score of 3.97 with an average score of 3.97. the average score is 3.95 so

that the material expert's assessment is declared valid. Furthermore, the data validation results from media experts are presented in Table 2.

Table 2. The result of media experts

Aspect	Average Value	Criteria
Visual Communication	3,95	Good
Software Engineering	3,92	Good
Quality of content and purpose	3,97	Good
Instructional	3,95	Good
Average	3,95	Good
Validity	3,95	Valid

From Table 2, it can be seen the average value of each aspect. Then from all these aspects, the average is 3.95. The validity of the props/motion analysis can be determined by changing the score to a scale of 5. Based on the results of the expert's assessment of the average value conversion material, it can be concluded that the props/motion analysis is declared valid.

Discussion

Testing props in the form of motion analysis was carried out after being declared valid and feasible to be tested by material experts and media experts. This is intended to determine the practicality of the developed

media. 4. Implementation. The trial was conducted on 30 people of STKIP Muhammadiyah Kuningan volleyball athletes. Table 3 is the result of the athlete's response questionnaire to small-scale trials.

The results from Table 3 show the average value of each aspect; then, from all aspects, the average is 3.51. The quality of the media can be determined by converting the average score with conversion guidelines to a scale of 5. From the results of the conversion of the average score, it can be concluded that the media, according to the small-scale trial, is good. After the product is revised and valid for use, it is tested in practice spike volleyball.

Table 3. Small-scale trial results

Aspect	Average Value	Criteria
Analysis Design	3,52	Good
Quality of content and purpose	3,45	Good
Instructional Quality	3,52	Good
Visual Communication	3,48	Good
Software Engineering	3,55	Good
Average	3,51	Good

The problem was conducted on volleyball athletes at STKIP Muhammadiyah Kuningan with ten students. This trial class was taught to see the effectiveness of the motion analysis device developed using

kinovea software, measured using a questionnaire on athletes. The results of the small-scale trials were revised and then continued to the medium-scale problems. The medium-scale test athlete response

questionnaire determines whether the props/motion analysis developed can be used properly. Table 4 is the result of the medium-

scale test questionnaire response questionnaire.

Table 4. Medium-scale trial results

Aspect	Average Value	Criteria
Analysis Design	3,85	Good
Quality of content and purpose	3,87	Good
Instructional Quality	3,82	Good
Visual Communication	3,86	Good
Software Engineering	3,86	Good
Average	3,85	Good

The results from Table 4 show the average value of each aspect; then, from all elements, the average is 3.51. The quality of the media can be determined by converting the average score with conversion guidelines to a scale of 5. From the results of the conversion of the average score, it can be concluded that the media, according to the medium-scale trial, is good. After the product is revised and valid for use, it is tested in practice spike volleyball. The problem was conducted on volleyball athletes from STKIP Muhammadiyah Kuningan with 20 students. This trial class was taught to see the effectiveness of the motion analysis device developed using the kinovea software, measured using a questionnaire on athletes. The field test athlete response questionnaire determines whether the props/motion analysis developed can be used properly. Table 5 is the result of the field trial questionnaire response questionnaire.

Table 5. Field trial results

Aspect	Average Value	Criteria
Analysis Design	4	Good
Quality of content and purpose	4	Good
Instructional Quality	3,95	Good
Visual Communication	4	Good
Software Engineering	3,98	Good
Average	3,98	Good

The results from Table 5 show the average value of each aspect, and then from all elements, the average is 3.98. The quality of the media can be determined by converting the average score with conversion guidelines to a scale of 5. From the results of the conversion of the average score, it can be concluded that the media, according to field trials, is good and can be used. 5. Evaluation. The evaluation stage is conducting an effectiveness test consisting of pretest and posttest or before and after using motion analysis assisted by kinovea software to increase the effectiveness of the spike in volleyball athletes at STKIP Muhammadiyah Kuningan. The pretest and posttest results are presented in Table 6 as follows.

Table 6. Volleyball spike pretest and posttest results

	Pretest	Posttest	N-Gain	Criteria
Training Design	65,4	71,3	0,56	Medium

Based on the analysis of data processing in table 6, it can be seen that the average value of the pretest is 65.4 while the average value of the posttest is 71.3. The N-gain value is 0.56 with moderate criteria. Therefore, there is a significant increase in the effectiveness of using motion analysis using kinove software, as seen from the pretest and posttest results.

CONCLUSION

The development of motion analysis on the effectiveness of spikes in volleyball games uses the ADDIE model, which consists of five steps: analysis design, development, implementation, and evaluation. The training model to be used must meet three indicators, including; (1) the validity of material experts and experts in volleyball and biomechanics media is valid, (2) practicality; the athlete's response stated that motion analysis using kinovea resulted in good criteria development, (3) effectiveness; the results of the pretest and posttest showed that the athlete's volleyball spike skills had increased.

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REFERENCES

Arif, A. P., & Sujarwo, S. (2021). Instrument Validity and Reliability Confidence to Jump serve in volleyball. *JUARA : Jurnal Olahraga*, *7*(1), 151-158. https://doi.org/10.33222/juara.v7i1.1433

Asmara, Y., Pitriani, P., & Mulyana, M. (2020). Suspension Training dan Weight Training Menurunkan Berat Badan, Visceral Fat dan Subcutaneous . *JUARA : Jurnal Olahraga*, *5*(2), 184-191. https://doi.org/10.33222/juara.v5i2.886

BeutelstahI, D. (2015). *Belajar Bermain Bola Voli*. Bandung: CV Pioner Jaya.

Dwi, D. R. A. S., Asmawi, M., Wasan, A., & Widiastuti, W. (2018). Pengaruh Metode Latihan Dan Power Tungkai Terhadap Peningkatan Kecepatan Akselerasi Sprint. *JUARA : Jurnal Olahraga*, *3*(2), 62-69. https://doi.org/10.33222/juara.v3i2.23

Dwiyanti, D., Hasneli, H., & Khairunnisa, K. (2020). The Correlation Between Dietary Habits and Physical Activity with the Somatotype of Game Sports Athletes. *JUARA : Jurnal Olahraga*, *6*(1), 39-49. https://doi.org/10.33222/juara.v6i1.1004

Habibie, Z. F., Santoso, D. A., & Candra, A. T. (2020). Variation Analysis of Body Position Angle of the Race Athlete on Sprint. *JUARA : Jurnal Olahraga*, *6*(1), 22-29. https://doi.org/10.33222/juara.v6i1.993

Hidayat, A., & Iskandar, D. (2019). Efektivitas

Underhand Servis Posisi Lurus dan Posisi Menyamping Terhadap Akurasi Servis Bawah. *JUARA : Jurnal Olahraga*, *4*(1), 62-67. https://doi.org/10.33222/juara.v4i1.452

Hidayat, I. (2013). *Biomekanika Olahraga*. Bandung: Ikip Bandung Press.

Knudson Duane. (2007). *Biomekanik (Fundamental Of Biomechanics Second Edition)*. USA: California State University.

Nasution, N. S. (2015). Hubungan Kekuatan Otot Lengan Dan Percaya Diri Dengan Keterampilan Open Spike Pada Pembelajaran Permainan Bola Voli Atlet Pelatkab Bola Voli Putri Kabupaten Karawang. *JUDIKA (Jurnal Pendidikan Unsika)*, *3*(2).

Peraturan Pemerintah No. 16 Tahun 2007 tentang Penyelenggaraan Keolahragaan.

Peter M. Mc Ginnis. (2005). *Biomechanics Of Sport and Exercise. United States Of America. Edward Brother. Inc*.

Qomariyah, M. T., & Herdyanto, Y. (2019). Analisis Gerak Open Spike Bolavoli (Studi Pada Atlet Bolavoli Surabaya Bhayangkara Samator, Ditinjau dari Aspek Biomekanika). *Jurnal Prestasi Olahraga*, *2*(4).

Ramadan, G., & Juniarti, Y. (2020) Metode penelitian: pendekatan kuantitatif, kualitatif dan R&D. CV Sadari Press

Rusdiana, A. (2020). Analisis Kinematika Gerakan Track Start dalam Olahraga Renang. *JUARA : Jurnal Olahraga*, *5*(2), 143-150.

https://doi.org/10.33222/juara.v5i2.881

Robert Maribe Branch. (2009). *Instructional Design: The ADDIE Approach*. USA: Springer New York Dordrecht Heidelberg London. https://doi.org/10.1007/978-0-387-09506-6

Saputro, D. P., Wijaya, M. R. A., & Dongoran, M. F. (2020). Analysis of Software Requirement Management Results for Physical Tests of Adolescent Pencak Silat Fighting Categories. *JUARA : Jurnal Olahraga*, *5*(1), 100-109. https://doi.org/10.33222/juara.v5i1.842

Santoso, D. A. S., & Irwanto, E. (2018). Studi Analisis Biomechanics Langkah Awalan (Footwork Step) Open Spike Dalam Bola Voli Terhadap Power Otot Tungkai. *Jorpres (Jurnal Olahraga Prestasi)*, *14*(1), 81–89.

Syaukani, A. A., Subekti, N., & Sudarmanto, E. (2020). Determining Physical Fitness for PPLOP Basketball Athletes in Central Java using Sport-specific Test and Measurement. *JUARA : Jurnal Olahraga*, *5*(1), 66-74. https://doi.org/10.33222/juara.v5i1.779

Sinurat, R., & Tofikin, T. (2021). The Identification of Sport Talents Using a Sport Search. *JUARA : Jurnal Olahraga*, *6*(1), 101-106. https://doi.org/10.33222/juara.v6i1.1154

Undang-Undang No. 3 Tahun 2005. Tentang Sistem Keolahragaan Nasional. Kementerian Negara Pemuda dan Olahraga Republik Indonesia.