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by Dani Riyadi

ANDROID APPLICATION DESIGN BASED ON BIOMECHANICAL ANALYSIS FOR PENCAK SILAT LEARNING, IT'S EFFECTIVE?

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Abstract

Android provides an open platform for developers to create their own applications that can be used to help perform daily activities. Media can used to support online learning or training has an impact on learning the skill. This study aims to look into to develop android application based on biomechanical analysis of pencak silat. The video with biomechanical analysis of pencak silat in android application was created with the Kinovea application and RAD Studio 10.3 software developer. Kinovea is used to analyze biomechanics (angle of motion) and make slow-motion videos. The content developed is the basic techniques and single artistic jurus, the name of this android application is "Analisis Biomekanika Jurus Tunggal Pencak Silat (Tutorial)". It has been found that 114 undergraduate students in physical education department who learn pencak silat material easily adapt to mobile learning. The application has not only been designed and tested, but it has also been in use for four months. This study's conclusions are based on practical rather than theoretical considerations.

Keywords: *Android Application, Kinovea; RAD Studio; Pencak Silat; Biomechanical Analysis*

INTRODUCTION

One of the original martial arts sports in Indonesia is Pencak Silat. (Lubis et al., 2021) whose materials are taught from elementary school to college through formal and non-formal education. Pencak Silat is competed from early childhood to adults. Basic techniques that must be mastered by pencak silat athletes are stance, attack, defense, slam, and fall. There are four categories of pencak silat matches, which are tanding (fighting), tunggal (single artistic), ganda (double artistic), and regu (team artistic) (Haqiyah et al., 2017). Tunggal is a category of pencak silat competition where an artist demonstrates their skills in a single standard of moves

with precision, accuracy, and soul (Haqiyah, 2019; Lubis, 2014). The primary value of Tunggal is the accuracy of the sequence of movements and steps. To achieve this, adequate learning and training strategies, including appropriate learning material, are required.

Teachers and coaches can utilize learning models to efficiently allocate current school learning time so that they can develop or focus on lesson subjects or abilities focused on the knowledge delivered to students in the classroom. Changes in the learning pencak silat course of higher education during the Covid-19 epidemic is that it is carried out with instructional approaches that utilize technology as a teaching online medium. These advancements have resulted in the learning model, in which knowledge is delivered outside of class through media (pencak silat video with biomechanical analysis), problem-solving, and/or group work. In an effort to provide material for a single martial arts step in the Covid-19 situation, the right media is needed, so that skills are still mastered even in limited situations (Haqiyah et al., 2021).

Previous research has explored the use of multimedia in the development of martial arts training, including the use of android apps and computer-based training (Marwan, 2014; Ricky et al., 2021; Sonya Nelson, 2018; Suwiwa et al., 2014) However, previous research has tended to focus on movement descriptions rather than biomechanical considerations (Kuragano & Yokokura, 2008). In a recent study, an android application was developed that shows segmental steps, slow motion, and is integrated with biomechanical analysis. The application was designed using RAD Studio 10.3 software developer with the content of single artistic jurus with slow motion video and biomechanics analysis using kinovea software (Kinovea, 2014) Biomechanics is a branch of science that studies the function of the musculoskeletal system and provides advice on how to improve it (Arus & Ingber, 2017). The advantages of this learning media are that it can make it easier for students or athletes to follow the movement and can perceive the

trajectory of motion with the help of the angle of motion and the proper sequence, so that it is expected to help athletes and students in learning jurus pencak silat. Three research questions were formulated to guide the purposes of this study. (1) How to developed an Android application design based on biomechanical analysis for pencak silat?, (2) How to investigate the interaction between item and person for studies on the educational structure of the android application ? (2) Is an Android application design based on biomechanical analysis for pencak silat effective based on evaluated sharing structure of the application?

METHOD

Participant

The participants included 114 undergraduate students in the physical education, sport, and recreation study program at Universitas Islam 45, Indonesia who were 19–21 years of age (age: M=20.31, SD=0.39). The student attends pencak silat lectures and is required to learn a single artistic category.

Data collection tools

The study utilized a questionnaire to gather data, which was designed with input from experts to measure students' opinions on android applications. The questionnaire consisted of 17 questions related to educational usage and 10 questions about sharing structure, each with a five-point rating scale.

Data Analysis

The study utilized SPSS version 25 (IBM Corp, 2017) for descriptive statistics and participant demographic profiles. Additionally, WINSTEPS version 5.2.5.1 software (Linacre, 2022) was used for Rasch analysis to investigate the interaction between item and person for studies on the educational structure of the android application.

RESULT AND DISCUSSION

Developed an Android application design based on biomechanical analysis for Pencak silat. Embarcadero is a software for programming GUI-based applications (Graphical User Interface) which allows users to interface with

application users using graphics. Through a GUI-based application, the users can give certain commands to the application that has been made without typing a command but using the available images. At Embarcadero, a choice of languages is available for programming, namely programming in C++ or programming in Pascal. Therefore, the Embarcadero software uses the C++ programming language called Embarcadero C++ Builder, while the Embarcadero software uses the Pascal programming language called Embarcadero Delphi. A programmer who uses Embarcadero software can choose a programming language that suits his abilities, for example, Pascal, so users simply choose to use Embarcadero Delphi software. In the Embarcadero Delphi software, the resulting application currently supports several devices and platforms or operating systems such as Microsoft Windows, IoS, and Android. Thus, this makes it very easy for programmers to create applications for several devices, one of which is an Android smartphone. In Embarcadero, to create an Android smartphone mobile application, you can use the Firemonkey Embarcadero Delphi feature with the Pascal programming language and select the Multi Device Application.

In the Multi Device Application form, you can choose a template, one of which is Tabbed with Navigation where in this template, a page has been provided which consists of 4 page tabs which can be opened by pressing on each page tab, so different pages will appear to fill in content, such as "Dashboard", "Theory", "Basic Techniques" and "Video Tricks" by changing the name on each page tab title. In the design of the android application made, you can enter a logo or layout the text and add several new menus on each tab. For videos, you can also add them by inserting the videos into an android application made through the "Resources and Images" menu, so that when the application is run, the video is already included in the android application without having to search for or add new files. Several video clips containing the movements of pencak silat have each been labeled. Therefore, it will be easier to call the videos according to their respective labels. For adding logos and embedding / inserting video files into the android

application. After inserting several videos, the next stage is adding content to fill in the "Theory" page tab. On the page tab, several page tabs have been created again to divide the content into several topics. Filling in content is done by writing texts on the Memo component that has been added to each page tab.

The next stage is to fill in the content material text and images on the "Basic Techniques" page tab. In this page, an additional new tab page is also created to be divided into several topics. In addition to filling in the content text in the form of material, this page also adds several images to complete the information on each material. The addition of images in making android applications. Then, make a video appearance menu on the "Steps Video" tab page. On this page, the video is divided into several steps and each step has several series of movements that are divided into several parts. To display the parts of this step, you can use the "Button" component which is renamed according to the parts of the step in the video that will be displayed. After all the designs are ready and neatly arranged, the next stage is to fill in the script program or program code in the android application that has been made. This can be done by filling in the program code on each button that has been made or selecting the "Code" menu on the bottom right page of the Firemonkey Embarcadero Delphi application. The final stage is adjusting the screen display to the size of the android smartphone device that will be used. The design of the android application for pencak silat uses a minimum screen size of 5 inches

The Content of single artistic made using Kinovea software for biomechanic analysis (Kinovea, 2014), which is an application for movement analysis, comparison, and evaluation (Guzmán-Valdivia et al., 2013). Kinovea is useful for watching slow motion videos and studying athletes' techniques, as well as being a RAD Studio 10.3 software developer. Kinovea is a video analysis program that is a free software application for analyzing, comparing, and evaluating sports and training. It is appropriate for physical education lecturers and coaches. The following are some of the benefits of this software: observation,

measurement, video comparison, etc. This program can also execute the analysis without the usage of physical sensors or reflecting markers, and it is simple to use (Muaza et al., 2018).

The video of a single artistic is analyzed as shown above using kinovea software so that the angle of motion and slow-motion can be seen. An display of the step movement in the android application:
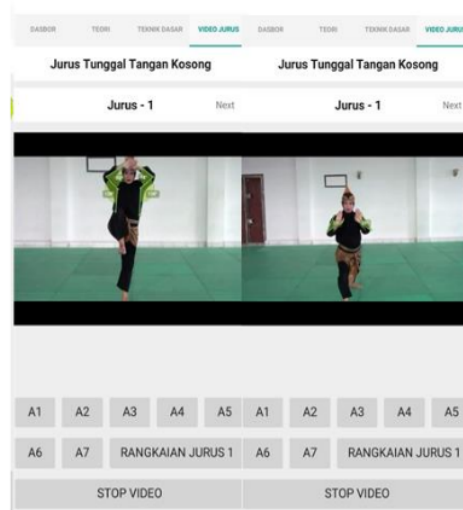
Figure 1. Android App Display

The video of pencak silat with biomechanical analysis was created with the Kinova program and made into an android application with software developer RAD Studio 10.3, which intends to make learning the movements of a specific art category of pencak silat easier for athlete and students. The precision of movement is the most important aspect of the assessment, thus students must memorize the movements and sequences completely.

Investigate the interaction between item and person for studies on the educational structure of the android application

Table 1. Result on the educational structure of the android application

No	Item	Mean	SD
1	The android application allows me to follow the lectures.	3.42	.841
2	Attending seminars does not encourage me.	3.10	1.216

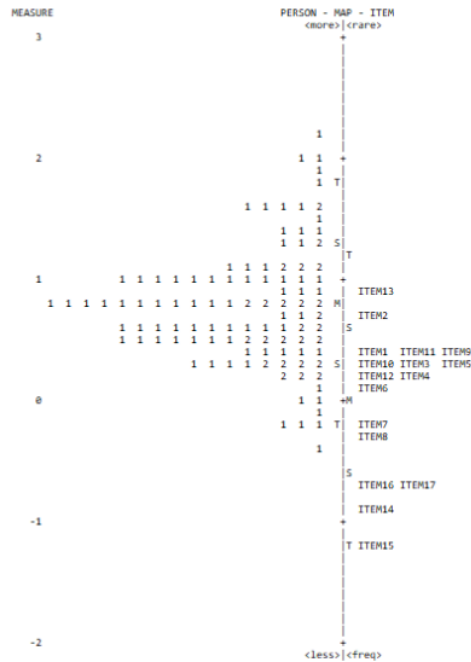| No	Item	Mean	SD
3	I have access to the course materials whenever I need them.	3.54	.772
4	The android application is materially rich.	3.59	.805
5	It is simple to see the video contents.	3.50	.878
6	I can study with the android application regardless of time or location.	3.70	.919
7	The android application helps lecture material learning.	3.99	1.148
8	It is an android application technique for me to provide course materials.	4.04	1.037
9	It can be used as a supplement to lectures	3.39	1.305
10	The android application improves educational quality.	3.47	1.057
11	The android application facilitates contact between students and teachers	3.42	1.254
12	The android application boosted my interest in lectures.	3.64	1.136
13	The android application design is appropriate.	2.91	1.520
14	It is simple to flip through the pages.	4.47	.833
15	The android application is a feasible option for interaction.	4.60	.742
16	I wanted to incorporate similar android application into future lessons.	4.34	.830
17	The android application is suitable for self-development.	4.32	.882

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Figure 2. [1] Person-item and item-person Wright Map

The item-person map is used to investigate the interaction between item and person for studies. As represented in Figure 2. The majority of respondents have higher ability above the item difficulty level which confirms the students have a good answer. We also perform the Item Characteristic Curve (ICC) based on instrument level. The ICC plot confirms that both studies fit the Rasch probability whereby the empirical and expected lines match or overlap each other (Figure 3).
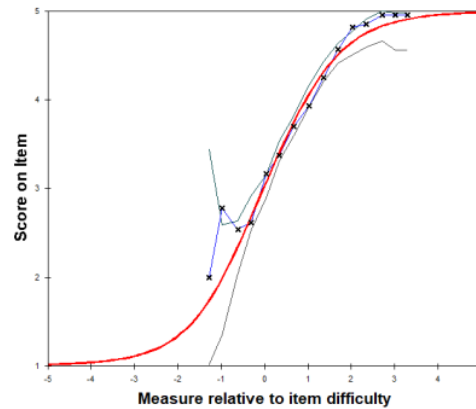
Figure 3. ICC plot; category probability of the questionnaire on the educational structure of the android application

Evaluated sharing structure of the application

Table 2. Result on the sharing structure of the application

No	Item	Mean	SD
1.	The android application is simple to use.	4.0095	.96571
2.	The screen design is simple.	4.1714	.89289
3.	It is simple to distribute the announcements page.	3.8952	.84266
4.	Video tutorials are simple to follow.	4.0095	.87151
5.	Tutorials are simple to understand.	4.0762	.89545
6.	An android application are simple to open and evaluate.	4.0571	.95905
7.	Complete content	4.4095	1.04417
8.	Biomechanical analysis makes it easy to understand movement	4.3524	.89851

Discussion

The significance of learning media android application for memorizing sports movements is increasing in the fields of physical education, sports, and health. Studies have shown that android-based mobile learning media is a feasible and effective tool for learning in these areas. Mobile sports apps have been found to be beneficial in promoting various physical exercise behaviors and exercise adherence among university students. Additionally, sports apps have been found to be useful for physiotherapy students to acquire professional competencies in evaluating and

diagnosing sports pathologies. The use of sports apps can also provide entertainment and a break from routine, which can influence the intention to continue using mobile sports apps. The combination of learning media with mobile learning has been found to be useful in practical learning related to physical education and sports. The use of sports apps in college sports education can enhance the quality of sports education and integrate sports apps with college sports education. Media, including learning media android application, is considered a crucial tool for learning both inside and outside the classroom, particularly in sports. The practical application research of sports teaching apps under the background of new media has been proposed to combine the characteristics of the information age. Injury surveillance and workload monitoring are important aspects of professional sports, including cricket, and the use of injury surveillance apps has been suggested. In summary, learning media android application for memorizing sports movements is essential in promoting effective and efficient learning in physical education, sports, and health.

Biomechanical analysis is a crucial tool for effective sports learning as it provides an objective method of evaluating the performance of a particular sporting technique. This is essential for improving sports and arts performance and preventing injuries. Biomechanical feedback is also a relevant key to improving sports performance. However, there are several challenges in the application of biomechanics to sports, which limit its application in the qualitative analysis of sport skills by many coaches. Nevertheless, the biomechanical analysis of sports technique by young athletes under the guidance of a coach is an important prerequisite for effective learning and a correct understanding of technical techniques. Biomechanics is also important in injury prevention and improving the performance of athletes. It is used in various techniques for recording and analyzing sports movements, and performance improvement and preventing injury using the analysis. Biomechanics is also used in mechanical and biomechanical analysis in sports as well as robotics laboratories. The effective use of the linear

statistical method in the mathematical modeling of the biomechanical characteristics and sports performances created the possibility to deepen the phasic preparation of sports training and to process more efficiently the modern didactic learning programs. Biomechanical simulation has become increasingly important in areas like orthopedic surgical planning, rehabilitation, sports medicine, and biomedical device analysis. The use of the video method of biomechanical analysis of sports technique has contributed to the more efficient learning of sports technique and to the achievement of better performances in competition. In conclusion, biomechanical analysis is crucial in sports learning, and its effective use can lead to better performance and injury prevention.

The final section is a summary, it consists of The Android application was developed using RAD Studio 10.3, which is an object-oriented approach to systems development that includes a development method and software tools. (Pandawa et al., 2019) RAD aims to shorten the time required in the traditional systems development life cycle between the design and implementation of an information system RAD Studio Rio (10.3) is a software that enables developers to create high-performance applications for various platforms, including Windows, macOS, iOS, Android, and Linux Server, using the same native codebase (Siswaja, 2015; Zulkifli, Natarsyah.S, 2021). It brings upgrades to VCL for High DPI displays, support per Monitor V2, new Windows 10 and WinRT APIs, and updated mobile platform support. The Android application was created using technical advancements and can be accessed online during the data transmission procedure. The Rapid Application Development (RAD) approach was used to create this application (Salamah et al., 2019). The use of media, such as visuals, audio, and video, is intended to stimulate students' interest and focus throughout the autonomous learning process (Mohamed et al., 2018).

Mobile phones have become a powerful tool for learning, both inside and outside the classroom (Sung et al., 2016). Students have provided feedback on the benefits of using mobile apps and technology for academic purposes (Chen et al.,

2015). By enabling mobile learning, students can collaborate in groups, which ensures a positive learning experience (Powell & Wimmer, 2016). The sharing structure of the Android application has been investigated, and students have shown that the usage of the program is simple, the content is complete, and the biomechanical analysis makes it easy to understand movement (Table 2). The ease and convenience of the application in this study indicate that attention is paid to the content of application creation and design (Table 1). Mobile developers should focus on user convenience by doing some research on effective text, using frameworks to provide user convenience, and making the application easy to change and reconfigure. Design, intuitive buttons, and quick content loading should be easy and straightforward to implement and apply, helping users feel comfortable (Aldayel & Alnafjan, 2017).

CONCLUSION

The android application of pencak silat with biomechanical analysis was created with the Kinovea software and RAD Studio 10.3, The content developed is basic techniques and single artistic jurus, the name of this android application is "Analisis Biomekanika Jurus Tunggal Pencak Silat (Tutorial)". Android application design based on biomechanical analysis is a medium created to help athletes and sports students to learn pencak silat. It has been found that undergraduate students easily adapt to mobile learning. As a result, an android application of pencak silat with biomechanical analysis was created inside this study to satisfy the demands of undergraduate students and coaches. The application has not only been designed and tested, but it has also been in use for four months. This study's conclusions are based on practical rather than theoretical considerations. An in-depth evaluation was also offered through the evaluation of the students' perspectives.

REFERENCES

Aldayel, A., & Alnafjan, K. (2017). Challenges and best practices for mobile application development: Review paper. *ACM International Conference Proceeding Series*, Part F1302, 41–48. https://doi.org/10.1145/3093241.3093245

Arus, E., & Ingber, L. (2017). Biomechanics of human motion: Applications in the martial arts: Second edition. In *Biomechanics of Human Motion: Applications in the Martial Arts: Second Edition*. https://doi.org/10.1201/b22446

Guzmán-Valdivia, C. H., Blanco-Ortega, A., Oliver-Salazar, M. Y., & Carrera-Escobedo, J. L. (2013). Therapeutic motion analysis of lower limbs using Kinovea. *Int J Soft Comput Eng*, 3(2), 2231-307

Haqiyah, A. (2019). *Pencak Silat*. Jakarta: PT. Rajagrafindo Persada.

Haqiyah, A., Lubis, J., Tangkudung, J., Muhamad, M., Kusumawati, M., Lanos, M. E., & Riyadi, D. N. (2021). Flipped classroom model integrated with the online learning platform and video biomechanic analysis to enhance learning outcome of Pencak silat during the Covid-19 pandemic. *Turkish Journal of Computer and Mathematics Education*, 12(11), 1489–1494.

Haqiyah, A., Mulyana, M., Widiastuti, W., & Riyadi, D. N. (2017). The Effect of Intelligence, Leg Muscle Strength, and Balance Towards The Learning Outcomes of Pencak Silat with Empty-Handed Single Artistic. *JETL (Journal Of Education, Teaching and Learning)*, 2(2), 211. https://doi.org/10.26737/jetl.v2i2.288

Kinovea, O. (2014). *Kinovea*. Motion Analysis Tool.

Kuragano, T., & Yokokura, S. (2008). Experimental Analysis of Japanese Martial Art. *Journal of Research - Japanese Martial Art Nihon-Kempo*, 7(1), 40–45.

Linacre, J. M. (2022). *Winsteps® (Version 5.2.2) [Computer Software]*. (5.2.2). Winsteps.com.

Lubis, J. H. W. (2014). *Pencak Silat Edisi Kedua*. Jakarta: Rajagrafindo.

Lubis, J., Sukur, A., Fitrianto, E. J., Suliyanthini, D., Irawan, A. A., Robianto, A., Haqiyah, A., & Oktafiranda, N. D. (2021). Wearing a fibrous protein (cv-f) cooling vest to reduce fatigue among indonesian pencak silat athletes: Is it effective. *Journal of Engineering Science and Technology*, 16(2), 1402-1415

Marwan, I. (2014). Learning single stance pencak silat through Computer Based Training (CBT). *Asian Social Science*, 10(5), 35–43. https://doi.org/10.5539/ass.v10n5p35

Mohamed, H. I., Eaganathan, U., Medi, I., & Sabri, N. A. (2018). Condominium visitors registration and tracking system. *Journal of Advanced Research in*

Dynamical and Control Systems 10 (1). 23-30

Muaza, N., Adnan, N., Nor, M., Ab, A., & Lee, H. (2018). Biomechanical analysis using Kinovea for sports application Biomechanical analysis using Kinovea for sports application. *IOP Conference Series: Materials Science and Engineering*, *342*(1), 0–9. https://doi.org/10.1088/1757-899X/342/1/012097

Pandawa, D. A., Dengen, N., & Setyadi, H. J. (2019). Aplikasi " U - FO Unmul " Sebagai Media Informasi Berbasis Android. *Jurnal Rekayasa Teknologi Informasi (JURTI)*, *3*(2), 172–180.

Ricky, E. N., Hudah, M., & Widiyatmoko, F. A. (2021). Pengembangan aplikasi pembelajaran pencak silat berbasis multimedia. *Altius: Jurnal Ilmu Olahraga Dan Kesehatan*, *10*(1), 40–52. https://ejournal.unsri.ac.id/index.php/altius/article/view/13990

Salamah, I., Lindawati, L., & Sitompul, H. Y. (2019). Final Project Guidance Application Using Android-Based Notifications. *J. Media Inform. Budidarma*, *3*(3), 232. https://doi.org/10.30865/mib.v3i3.1216

Siswaja, H. D. (2015). Pengembangan Aplikasi Android Menggunakan Firemonkey. *Media Informatika*, *14*(1), 42–56.

Sonya Nelson, S. (2018). Pengembangan Model Pembelajaran Teknik Dasar Pencak Silat Berbasis Multimedia Di Fakultas Ilmu Keolahragaan Universitas Negeri Padang. *STAMINA*, *1*, 474–481. https://doi.org/10.24036/jst.v2i2.164

Sung, Y. T., Chang, K. E., & Liu, T. C. (2016). The effects of integrating mobile devices with teaching and learning on students' learning performance: A meta-analysis and research synthesis. *Computers and Education*, *94*, 252–275. https://doi.org/10.1016/j.compedu.2015.11.008

Suwiwa, I. G., Santyasa, I. W., & Kirna, I. M. (2016). Development of interactive multimedia learning in pencak silat theory and practice courses. *Jurnal Teknologi Pembelajaran Indonesia*, *6*(1).

Zulkifli, Natarsyah.S. (2021). Travel booking application model at CV. Mitra Tour & Travel Company based on Android. *Jutisi: Jurnal Ilmiah Teknik Informatika dan Sistem Informasi*, *10*(1), 97-110

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