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Augmented reality mobile app-based multimedia learning of Pencak Silat to enhance the junior high school students' learning outcomes

Nur Rohmah Muktiani[1*], Soegiyanto[1], Siswantoyo[2], Setya Rahayu[1], Hedi Ardiyanto Hermawan[2]
[1]Post-graduate Programs, Universitas Negeri Semarang, Indonesia
[2]Faculty of Sport Sciences, Universitas Negeri Yogyakarta, Indonesia
*Corresponding Author: nmuktiani_fik@yahoo.com

ABSTRACT

The present study aims to produce Augmented Reality Mobile App-based multimedia of Pencak silat learning for junior high school students. APPED Research and Development model was applied by following several stages, including Analysis and Initial Research, Design, Production, Evaluation, and Dissemination. The data were collected using questionnaires and tests. The product was evaluated in three stages, namely one-to-one, small group, and field (effectivity test) evaluation. Three material experts were involved in rating the product validation with a mean of 4.77 (very good). Meanwhile, the mean score from three Media Experts was 4.80 (very good). The mean score of product evaluation for one-to-one evaluation was 4.62 (very good), the small group at 4.80 (very good), and the field at 4.56 (very good). A significant improvement was detected in the mean score of the learning outcomes from pretest to post-test ($p=0.000<0.05$). Therefore, it can be concluded that Augmented Reality Mobile App-based multimedia of Pencak silat learning was effective to improve JHS students' achievement and was able to be used in the Pencak silat learning for JHS students.

Keywords: Learning Multimedia, Pencak silat, 3D, Augmented reality

Article history

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INTRODUCTION

A massive change in the current educational paradigm has become the world's serious attention. A report from China WHO about a virus called The Corona Virus Disease 2019 (COVID-19) spreading in the Wuhan region was the turning point of the event. WHO finally announce COVID-19 as a global pandemic on March 11th, 2020. The situation worsened with many mortalities caused by the virus. The pandemic situation forced all people to limit their actions by distancing themselves and complying with the health protocol set by WHO. The government, as represented by the Ministry of Education and Culture issued a Circular letter to the Local Government in a letter numbered: 36962/MPK. A/HK/2020. The circular letter becomes the foundation for most schools in Indonesia to implement Distance Learning. This learning method leads to a change in learning patterns, from traditional face-to-face or offline learning to online learning (Rozi et al., 2021).

In addition, the pandemic situation ignites a change in learning methods, particularly for Health and Physical Education (HPE) in schools. Implementing technology for learning is not a big deal; instead, it eases the learning since the interaction between students and teachers can occur immediately which enables them to share information anytime and anywhere (lifetime education) (Mendrofa, 2021). HPE differs from other courses since HPE involves many physical

activities in the learning process. HPE learning needs to keep running and maintains its quality. The learning quality thus becomes a heavy challenge for the teachers. Teachers are believed as the spearhead of learning, so their roles are crucial in the development of the learning process (Mahardika et al., 2021).

Quality learning according to curriculum 2013 emphasizes learning to develop critical thinking by encouraging students to be active. In a standard process, for instance, teachers are required to implement learning with an approach (Wicaksono & Utama, 2020). To manifest quality learning, special attention is required since it involves many learning components. The elements in learning are also commonly known as components (Herlina & Suherman, 2020). All components synergize to produce effective learning. Those components include teachers, students, learning objectives, materials, media, methods, and evaluations (Saragih, 2008).

The present article specifically focuses on the media component. The utilization of media is supposed to be a part that requires the great attention of the learners in a learning activity (Wicaksono & Utama, 2020). The learning process can be effective only if the communication and interaction between teacher and students can occur intensively (Inah, 2015). The increase of learning quality can be carried out gradually, planned, systematic, purposeful, and intensive in the current globalization era (Manullang, 2014). During the pandemic, the learning can be conducted by applying a learning-from-home scheme, whether it is a synchronous or asynchronous communication strategy. Teachers can select one of the methods or combine both (Fahmi, 2020).

It is suggested that both Synchronous and Asynchronous communication strategies in learning need to be multi-way, instead of only one-way communication (Apsari et al., 2020). A reciprocal relationship can occur between students and teachers, or between students and their peers. Therefore, the teacher can act as a sender and receiver of the message. Proper communication will provide an opportunity for an individual to obtain appropriate information that will enhance the learning quality. Learning is communication, and it is worth noting that the message shared during the process can be received appropriately according to what it is sent. In learning, the message is the learning material, which makes a technology involvement crucial to support students in understanding the material. An abstract, complex, and hard-to-understand material need an appropriate media to be prepared by the teacher according to the learning needs. Several factors to consider include the learning objectives, students' characteristics, and learning material properties (Budiningsih, 2015).

Physical Education in the Indonesian context contains a curriculum of local motion, such as martial arts. Pencak Silat is one of the forms of martial arts, which is a martial art inherited from the ancestors of the Indonesian nation (Saputro & Siswantoyo, 2018). Pencak Silat learning in school is conducted by practicing the basic movements of Pencak Silat. The characteristic of Pencak Silat material is very unique, which includes an understanding of many Pencak Silat terms, an overall picture of the intended movement, and various information needed (Muktiani, 2014). Pencak silat material in Curriculum 2013 is included in the sport and recreational, which makes it a nation's mandate (Muktiani et al., 2020).

The role of HPE teachers in conducting Pencak Silat learning in HPE is to provide the students with an appropriate martial art learning experience. In a preliminary study, several HPE teachers participated in Focus Group Discussion (FGD) described that they were aware of their job to teach pencak silat material, but they admitted that lack of mastery of the material was their biggest challenge (Muktiani et al., 2020). Therefore, the teachers have a limitation in preparing and explaining the materials. The teachers are eager to teach the material, but they tend to hesitate, and it resulted in a few teachers to teach the material in practice. Most of the teachers do not teach and some others only explain the theory without any practice. When teachers learn from the available resources such as books, teachers were found to have a hard time in observing the sets of movements from the beginning to the end of the movement.

In this light, teachers need a learning tool and a clearer and more interesting learning model. How the learning resources are able to show a movement with a surreal sequence. There are several media such as learning videos that are able to show a set of movements, but the users are unable to see the movement from the user's desired position. The viewpoint depends on the developer of the media. The preliminary study also provides information that teachers need a learning media that can be seen from all sides, so it helps to understand the learning material. It is crucial for the users to learn how to practice the movement pleasantly.

It is inferred that the higher the interactivity between users and media, the easier it is for the learning material to be understood by the users. Hence, the function of learning media as a learning aid can be achieved. Teachers also want the learning media to be accessible not only for teachers, but also for students to learn in and out of the school for independent learning. Utilizing technology in HPE learning can be a solution, so that the teachers can own a learning aid/media in teaching. Utilizing technology is also considered an appropriate alternative for distance learning. A suitable learning aid can be designed based on the condition of users, material, and learning objectives. The selection of media can be in a form of multimedia, hypermedia, virtual reality, interactive multimedia, and so forth. Various selection of media may be suitable to overcome the problems in learning during the pandemic or after the condition is back to normal.

From the problems explained in abovementioned discussion, an interesting solution lies within the importance of owning a learning media that can be used as a learning resource and ease the students in understanding the material. Currently, technology has advanced rapidly. Virtual technology is a current trend in the world of business, Health Education, entertainment, military training, medical, engineering design, robotic and telerobotic, manufacture, education, and so forth (Mustaqim, 2016). The Augmented Reality (AR) technology has gained its popularity in the world of medical business, tourism, entertainment such as a filtered photo as a feature in Instagram platform accessible from any smartphone that has been used by many Indonesian people. Although many people were not aware that this feature use a technology called augmented reality. AR is a technology that can combine real world and virtual world in 3D form, and it is real-time interactive (Brata & Brata, 2018). Augmented reality or better known as AR is in a 3D form, which allows the users to see the model/character from different positions. AR is useful to enrich the users' experience, enhance perception, and interaction of the users with their real life. A lot of information from virtual world that can lead the users to act in real world. For example, if the material is about T kicks, then the character in virtual world will demonstrate the movement repeatedly to help the users in understanding the movement.

In order to overcome internet accessibility problem at home, a suitable alternative is by creating an application. The students can download the application at school and used it later to study at home. The major role of teacher is designing, developing, managing, implementing and evaluation the learning (Wahid, 2018). It is crucial to build an innovation in learning. Innovation is widely defined as a creation of new stuffs or an update of something (Primayana, 2019). Learning must be designed consciously and prioritize students in achieving the competence. The end point of aa learning is the achievement of learning goals, namely a change of students' behavior (Wahid, 2018). Considering the situation, it is necessary to conduct a research and development of multimedia application for pencak silat learning using Augmented reality for JHS students in Yogyakarta.

The product developed in the present study is a mobile learning application as a part of learning multimedia models by utilizing smartphone as a tool or device. In the past decades, smartphone is widely used by many people as a communication tool. The uniqueness lies within this wide use of smartphone, since the developed application attempts to invite the users to utilize smartphone as a tool for learning, and it applies for students, teachers, and public. With the use of smartphone, the application can be downloaded and used to learn at school or anywhere. There will be no more internet dependance after the application is downloaded into the device. It is considered sophisticated, which means that the development of learning multimedia in Virtual Era 4.0 in a form of 3D AR-based mobile application can be operated with smartphone. Technology is involved to ensure the effectiveness and efficiency of the product. AR technology is an integration of digital element into real world and it follows the situation of the real environment (Tahyudin et al., 2015).

Another characteristic is innovative, in which the learning is designed by teachers based on new ideas to create stages in learning with the new technique or method, in order to produce a method for the students to be enthusiastic in learning. An innovative learning is defined as a learning prepared by the teachers as a manifestation of considerably new ideas to maximize the students' learning outcomes and their interest in achieving learning progress. Learning media such as power point presentation, pictures and videos are commonly used by the students in learning Health and Physical Education. It is certainly exciting to provide students with a learning experience by facilitating them to learn using an application-mediated material. It offers a new

experience since it utilizes augmented reality-based multimedia with 3D picture characters as a recent innovative product. Sometimes, using Laptop PC requires a spacious place and is less practical. Therefore, it proposes to establish a creative and innovative learning culture for all students by implementing ICT-based learning material/media. In this vein, the present research and development aims to produce a product in a form of Augmented Reality Mobile App-based Learning Multimedia for Pencak Silat to ease the material understanding for junior high school, analyzes the product effectivity, and analyzes the product acceptance.

METHOD

The present study employed Research and Development method, a research method used to produce a particular product, and to test the product effectivity. The product developed in this research is a Augmented Reality-based learning application for Pencak Silat learning that can be used by junior high school students in Yogyakarta. The procedures from Borg dan Gall (1983) was adapted in this research, which was divided into four research stages, including Analysis and Initial Research, Development, Field Testing, and Dissemination (Ghufron et al., 2007).

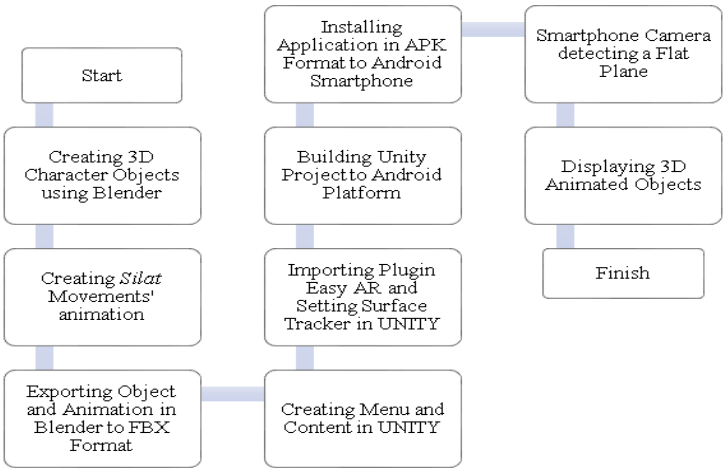

Figure 1. Flowchart of AR-based Multimedia Product Development

After the initial product was finalized and evaluated by Material Experts (3 Experts) and Media Experts (3 Experts), the product was tested to the students in three stages (Sadiman et al., 2002). The evaluation was started with one-to-one evaluation towards four students representing the groups of below-average and above-average students. Small group evaluation was conducted to 10 students consisted of smart and less smart students, males and females. The last evaluation, field evaluation, was conducted to 30 students with different characteristics, proficiency levels, gender, and the appropriateness with user candidates. The selection of tested students was assisted by the HPE teacher. A total of 44 students of SMPN 2 Mlati Sleman were involved in the product testing. The data were collected using questionnaire and pencak silat material comprehension test. The questionnaire data on the product assessment were used to assess the product quality, and the instrument of pencak silat material comprehension test was used as a foundation for product improvement. The quantitative data were analyzed using descriptive statistic, while the qualitative data from material and media experts and the student were analyzed and abstracted for product improvement. The steps for crude data collection, scoring process, scoring conversion in five scales using the conversion reference from the Benchmark Reference Approach (Sukarjo, 2005).

Instrument validity was obtained from five experts' assessment that was analyzed using Aiken's index formula. The assessment of developed product was conducted using Likert scale model from 1 (one) to 5 (five) with each scale described sequentially as very good, good, fair, poor, very poor. Based on the entire validity assessment by five experts that consisted of two material experts and three media experts to the developed product, it showed that MUKTI instrument had been designed and developed with a mean score of 0.93. It showed the validity of

MUKTI instrument. The recapitulation of the entire validity assessment results from the five experts is presented in Table 1.

Table 1. Assessment Results from All Validators

	Factors assessed by the experts	
	Material	Media
Aiken Score	0.94	0.92
AIKEN'V Mean	0.93	

Based on the result of score conversion, a value of the developed learning multimedia product was obtained. The data obtained from pretest and posttest were analyzed with descriptive statistic. SPSS Statistic 26 software program was used to examine the result of paired sample t-test to understand the effectivity of multimedia product in learning.

Table 2. Assessment Criteria

Grade	Criteria	Score	
		Formula	Calculation
A	Very Good	$X > \overline{Xi} + 1{,}8Sb_i$	X > 4,21
B	Good	$\overline{Xi} + 0{,}6Sb_i < X \leq \overline{Xi} + 1{,}8Sb_i$	3,40 < X ≤ 4,21
C	Fair	$\overline{Xi} - 0{,}6Sb_i < X \leq \overline{Xi} + 0{,}6Sb_i$	2,60 < X ≤ 3,40
D	Poor	$\overline{Xi} - 1{,}8Sb_i < X \leq \overline{Xi} - 0{,}6Sb_i$	1,79 < X ≤ 2,60
E	Very Poor	$X \leq \overline{Xi} - 1{,}8Sb_i$	X ≤ 1,79

Results

The research and development process were conducted simultaneously. The data collection and processing were part of the research. The development process was started with the product design. After designing the product, MUKTI was created, and an initial product was produced. The product design aimed to compile the material content and the display of augmented reality mobile app product.

The material for AR movements was compiled according to the flow of pencak silat movements and designed according to the needs. The design was created for the displayed material to be organized and simple, so the students could understand better. The following is an example of several design/storyboard display and the production result. Initial product description in this research was divided into display part: A literature study, preliminary research on the current pencak silat learning model, and FGD with HPE teachers were conducted before a storyboard was made. An information obtained from FGD that HPE teachers admitted they were in need of a support for learning media and resources that can be accessed easily. The teachers also needed an interactive multimedia for pencak silat. The development of multimedia learning for pencak silat was initiated due to an urgent needs of learning aid. The change of learning method to scientific method that emphasizes on the development of students' critical thinking led the teachers to implement Technological, Pedagogical, and Content Knowledge (Fajero et al., 2021). It can be inferred that the technological learning and application were able to facilitate the students with a supporting tool to prepare the material.

Video taking to be used as a guideline for AR movements was immediately conducted after designing the product. The video was taken from three perspectives simultaneously. The character was design based on the objectives before creating an animated movement. Character is crucial since it will convey the intended message or story, so the character element will be firmly embedded in the users' memory.

Fictional character or figure in a media realm is commonly called a Character. Character is a person, persona, or a figure is initially from fictional realm (Wuryanti & Kartowagiran, 2016).

A character design in learning media certainly consider several aspects, including making it a neutral character without any specific interest, interesting, and can be developed.

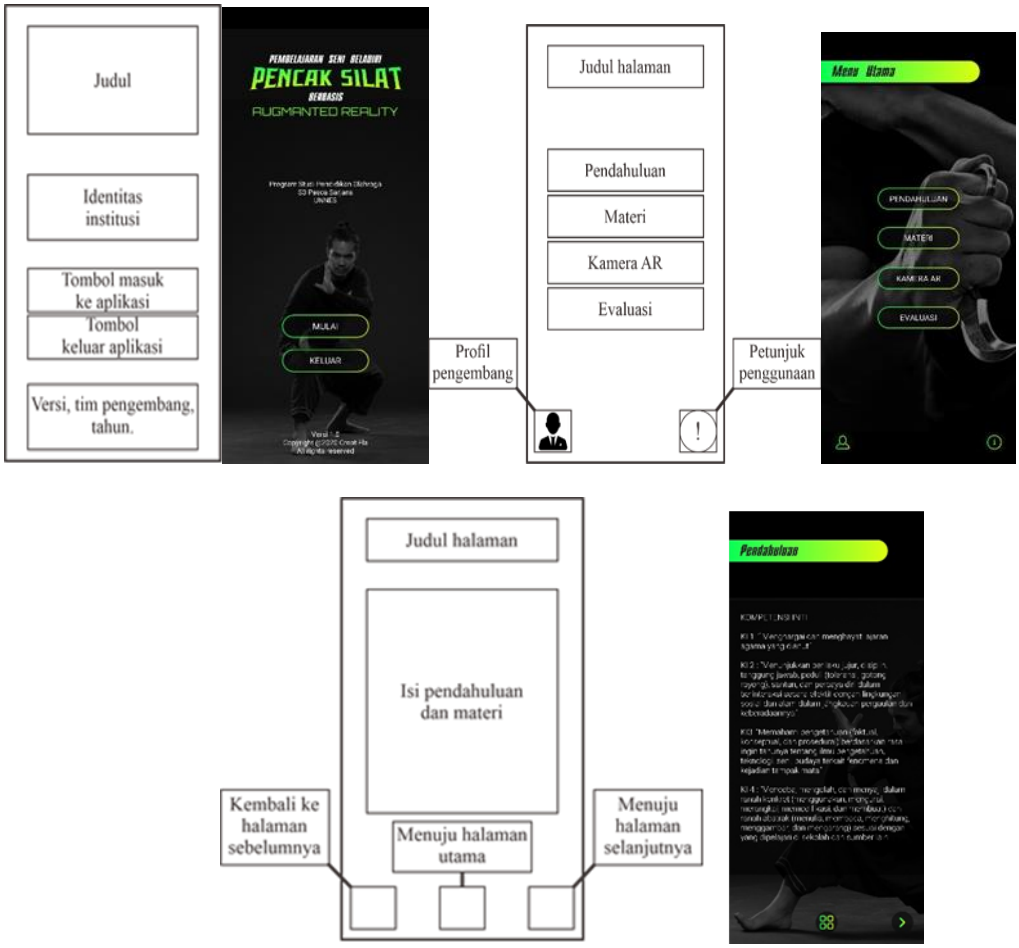

Figure 2. Storyboard of the initial product

A visual approach of character design in MUKTI application was created with a visual of a student/learner/silat athlete in pencak silat uniform in accordance with the color of IPSI, black. The character was selected as an asset that can move according to the video model made during the video recording, so that it could be developed for other more variative movements.

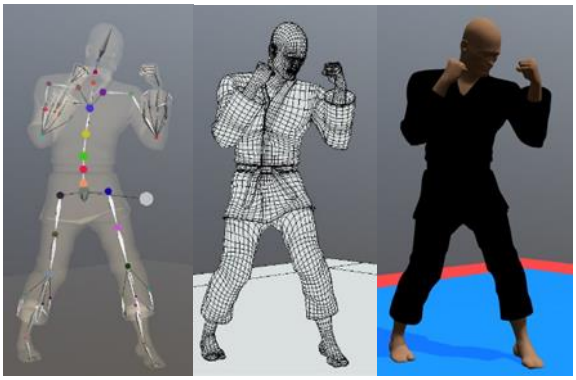

Figure 3. 3D Character Object Designing Process

Figure 4. Animated movement designing process

The following procedure (Figure 5) was importing 3D object picture and animation into FBX format, creating menu in UNITY system and importing plugin easy AR.

Figure 5. Importing Picture to UNITY

The next process was setting the surface Tracking and importing 3D object and the animation. Below is the picture of initial product from MUKTI application. After the initial product in a form of application for pencak silat learning was finalized, it was followed by a testing. Generally, the objective of evaluation was to discover the quality and effectivity of the developed product.

Figure 6. Button of MUKTI application

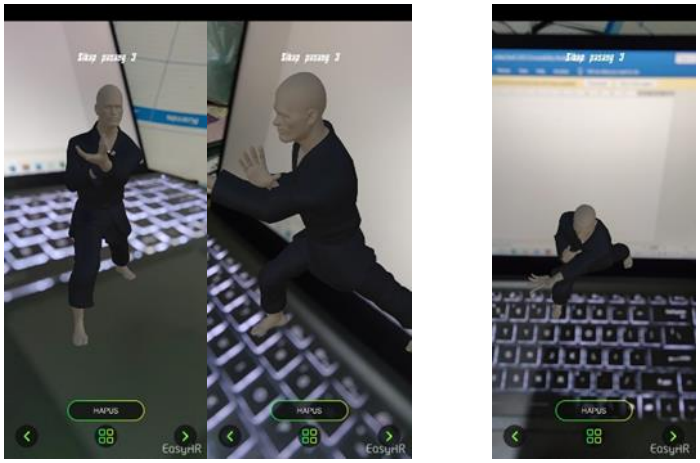

Figure 7. Take-off Position 3 from Different Positions

The product evaluation consisted of formative and summative evaluations. Formative evaluation was conducted during the development process, while the summative was conducted when the product was finished and ready to use (Surjono, 2017). In the formative evaluation stage, this initial product was assessed by the Experts before conducting summative evaluation, which was the product testing to the user candidates.

The evaluation process began with formative evaluation, phase I was the evaluation from material expert. The assessment began by assessing the product material, namely the application of AR-based pencak silat media. Three Pencak Silat material experts were involved, the first one is professor with an expertise in Pencak Silat. He is a lecturer and teaches Pencak Silat course. In addition, he is a member of Executive Board of the Indonesian Pencak Silat Association (PB IPSI). The second material expert is a doctor with an expertise in Pencak Silat. He is also a lecturer of Pencak Silat course, and a member of PB IPSI Agency for Standardization and Accreditation. Meanwhile, the third material expert is also a Doctor in Pencak Silat, and a member of PB IPSI Trainer Agency. The competency of the three experts on the Pencak Silat field was a strong reason for their appointment as material experts. They are researchers in Pencak Silat field and participate actively in the organization such as Refereeing, National Trainer, PB IPSI board member, as well as Lecturer at Faculty of Sport Sciences.

To obtain data from experts, the product and evaluation sheet were sent to the material experts. After receiving the product and evaluation sheet, the experts were trying to operate and assess the product. The experts immediately scored the instrument in the provided form after operating the product. The validation result from material and media experts can be seen in Table 3.

Table 3. The validation results of material experts

Validator	Aspect							
	Learning		Criteria		Content		Criteria	
	I	II	I	II	I	II	I	II
1	4.29	4.59	Good	Very Good	4.38	4.50	Very Good	Very Good
2	4.65	4.94	Very Good	Very Good	4.50	4.88	Very Good	Very Good
3	4.71	4.88	Very Good	Very Good	4.75	4.88	Very Good	Very Good
Mean	4.55	4.80	Very Good	Very Good	4.54	4.75	Very Good	Very Good

Material experts assessed two aspects of the material, namely learning and content/material aspects. The learning aspect consisted of the clarity of the core competencies formulation, conformity of the basic competencies and core competencies, accuracy of the theme, clarity of the program name, accuracy of the mediated material selection, suitability of the material and the topic of discussion, systematically planned material, suitability of the material with current science and technology, interactivity, suitability of the cognitive capacity and the users' improvement, clarity of the target users, users' control, suitability of the question items and the

material, quality of the question items, quality of the feedback, availability of the answer key, and easy to understand language. Meanwhile, the content/material aspects included the suitability of material and objectives, correctness of the content's structure, accuracy of the material content, correctness of the grammatical, spelling, terminologies, and punctuations, and suitability of the difficulty level and the users.

The three material experts commented that the product in a form of application called MUKTI was believed to be fascinating for students and teachers. The product can be used to learn, both independently and traditionally. Moreover, the product was enthralling and motivate students to learn since the display resembles the reality. It benefitted the teachers since it helped them in doing their job, especially when the teacher had no basic knowledge on the material art particularly on pencak silat. The product can be very helpful when the teacher explains the material.

The three material experts also provided a recommendation that the product should use attractive name. The product name is inscribed in the application's cover/ home page. Another recommendation was that the naming of pencak silat movement's terminologies must be adapted from the movement's terminologies from IPSI. Then, the product needed to be verified on the horse-standing and take-off position of the AR movements. The material experts suggested that the product should be continued and used to improve independent learning and to provide useful information according to the needs and advancement of the Alpha generation.

The evaluation proceeded with assessment of the media experts after material experts had finished assessing. The first media expert is a lecturer in Physical Education Learning Technology course, and he got his Doctor of Philosophy Degree from State University of New York at Albany. The second media expert is a Professor in the field of physical education with a degree of Doctor of Philosophy (Ph.D) in Health and Sports Science from Kyushu University, Japan. Last, the third media expert is a senior lecturer of Physical Education Learning course with a Doctoral degree from the Postgraduate School Universitas Negeri Yogyakarta. The assessment result of the media experts is presented in Table 4.

Table 4. The Validation Results of Media Experts

Validator	Aspect							
	Display		Criteria		Programming		Criteria	
	I	II	I	II	I	II	I	II
1	4.69	4.88	Very Good	Very Good	4.25	4.63	Good	Very Good
2	4.63	4.75	Very Good	Very Good	4.88	5.00	Very Good	Very Good
3	4.56	4.69	Very Good	Very Good	4.75	4.88	Very Good	Very Good
Mean	4.63	4.77	Very Good	Very Good	4.63	4.83	Very Good	Very Good

The evaluation from the media experts consisted of the aspects of product display and programming. Assessment for the display aspect included the accuracy of application program selection, background color selection, text color selection, font selection, accuracy of font size, compatibility of font and background colors, layout, clarity of character's pictures, attractiveness, character 's appearance, compatibility of adaptive character's size, attractiveness of the animation, relevance of animation and the material, button placement, consistency, and size, and accuracy of the button color selection. Meanwhile, the programming aspect included the ease of application downloading, efficiency of the mobile data usage, clarity of the application usage instruction, ease of the application usage, navigation function, navigation consistency, clarity of the navigation structure, and ease of the button usage.

In addition to the quantitative assessment, the material and media experts provided abstracted comments and recommendations. Media experts commented on the product that product development in a form of application is very appropriate and advance in the current situation. The product is practical to be utilized for motion learning, infiltrating any time, place, and distance boundaries. The product is in a form of 3D moving picture and considered to be very appropriate for learning. The media experts suggested that this learning application product needs to be named attractively and equipped with child's picture in accordance with the users' age,

instead of using adult's picture as in the initial product, and a verification of developer's profile was needed to be customized.

Table 5. MUKTI product testing

Assessment Aspect	Testing Score			Mean	Category
	One to one	Small group	Field		
Display	4.53	4.78	4.57	4.63	Very Good
Material	4.64	4.68	4.57	4.63	Very Good
Pedagogical	4.75	4.92	4.54	4.74	Very Good
Motivation and Readability	4.58	4.83	4.55	4.65	Very Good
Total of Mean Score	18.49	19.21	18.22	18.65	Very Good
TOTAL	4.62	4.80	4.56	4.66	Very Good

The process following the formative evaluation process was the summative evaluation by conducting a testing to the user candidates. One to one, small group, and field testing were conducted in this evaluation stage (Sadiman et al., 2002). The final recapitulation of the one to one, small group, and field testing is displayed in Table 5. In addition, Figure 8 presents the bar diagram of the evaluation results, which included one to one, small group, and field testing.

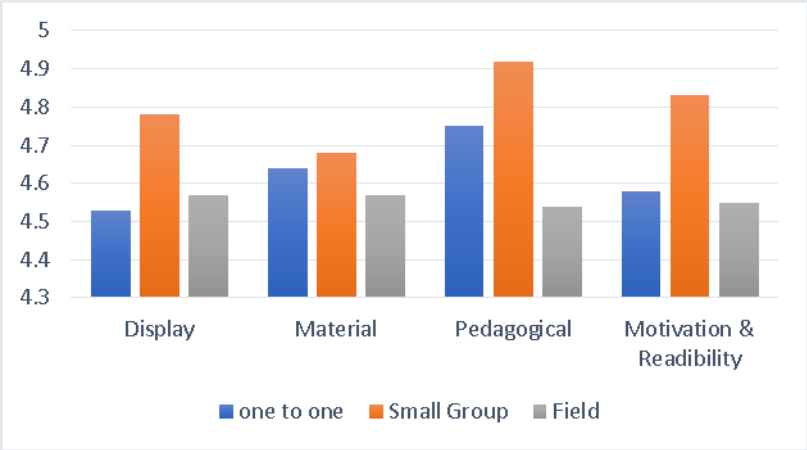

Figure 8. Product evaluation result

Product's acceptance testing was carried out by the students using the product to learn Pencak Silat. Students commented and provided suggestion for the product. Several students perceived that it was their first-time using AR-based application to learn Pencak Silat. The application was considered excellent, interesting, useful and suitable for learning. The moving character can be seen from all directions or in 3 Dimensions format, which makes the pencak silat learning to be easy, fun, and not boring since the material is explained in short but clear. It implied that the product suited the students and material's characteristics. In addition, it suited the needs, in which it could be used as the students' learning resource to solve the problem in pencak silat learning material. Moreover, the students suggested that the character should be reproduced and made more attractive for the product improvement in the future. Students also suggested that the application should add more features, and they expected for all courses to use similar application.

The recommendations from the material and media experts, and the students were used as a foundation for product's revision. However, due to the researchers' limitation, not all suggestions could be realized, such as a change of character's appearance. Therefore, the character's appearance remained using the initial model. Some of the product revisions could be done, including profile customization, product and home page naming, verification of all movements, and addition of junior high school student image. The recommendations were immediately followed up by revising the product. Figure 9 presents the picture after the revision process, which displays the suggested profile picture to be verified and customized. Since there was a change in developer personnel, the profile picture was adjusted.

Figure 9. Revision of Developers' Profile

All experts suggested that the product should be named, and it should be inscribed in the application's home page. Revision was completed, and the initial picture, that was an adult male, was changed into female silat athlete in school age.

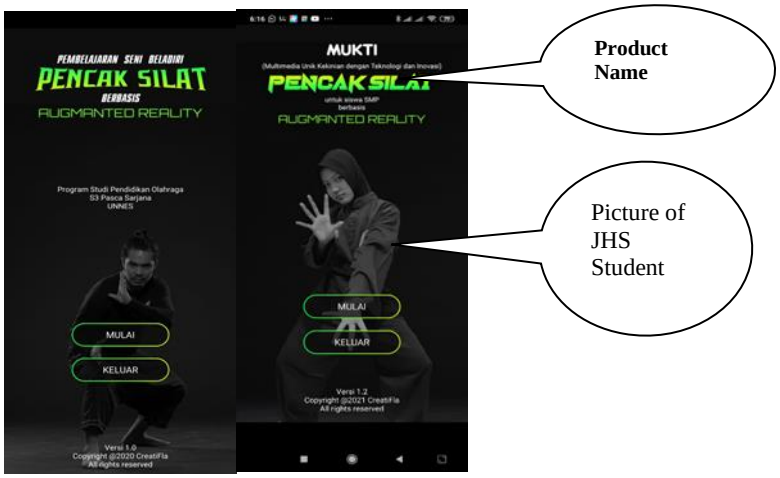

Figure 10. Revision of Product Cover and Name, and Picture of a Student

The addition of Horse-Standing Movement in Pencak Silat was the next to revise. It initially did not exist, then the product was revised based on the experts' recommendation by adding the Horse-Standing Movement. The revise version of the movement is presented in Figure 11.

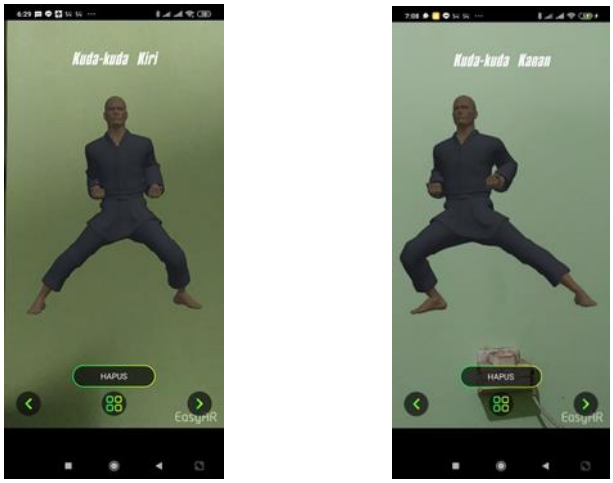

Figure 11. Revise version of the horse-standing movement

Paired sample t-test using SPSS 26 software was applied to discover the effectiveness of AR-based MUKTI learning application. Table 8 shows that the significancy value (2-tailed) was 0.000 ($p<0.05$). It implied that a significant change was found from the pretest to posttest score. Therefore, it can be concluded that the augmented reality mobile app-based multimedia for pencak silat learning was effective to improve the JHS students' learning outcomes. It showed that the posttest score was higher than the pretest score. However, the range of data distribution/standard deviation of the posttest was getting bigger with a higher standard error.

Table 8. Result of paired sample t-test

Test	Mean	Std. Deviation	t	df	Sig. (2-tailed)
Pre	43.39	10.369	-15.909	27	.000
Post	80.00	11.139			

Discussion

Pencak Silat is a unique martial art, which combines art, sport, martial art moves, breathing techniques and psychic. There are "Pencak Silat Rules" that makes it more fascinating (Maryono, 2017). The parent of Pencak Silat organization in Indonesia, the Indonesian Pencak Silat Organization (IPSI), is the house of various pencak silat academies in Indonesia (Pratama, 2018). Pencak Silat is full of Indonesian nation's original personality elements inherited from generation to generation as part of Indonesian ancestral culture. Some personality elements in pencak silat can strengthen the physical and personality of young generation, as well as growing a sense of nationalism with the original Indonesian style (Mufarriq, 2021). Pencak Silat is often used to unite the Indonesian people (Kumaidah, 2012). Pencak Silat is very appropriate to be taught in school and used as a tool for character education (Jannah R, 2018). In addition to be used as a tool for character education, Pencak Silat was appointed by UNESCO into the Representative List of the Intangible Cultural Heritage of Humanity, according to the 14th session of the UNESCO Intangible Cultural Heritage Committee that took place in Bogota, Colombia on 12th December 2019. The United Nations Educational Scientific and Cultural Organization (UNESCO) had currently appointed Pencak Silat as intangible world cultural heritage (KEMENLU, 2019).

The current HPE Curriculum in Indonesia includes Basic Competencies of martial arts (Permendikbud, 2018). Pencak Silat as Indonesian ancestral martial art heritage is certainly worth to be preserved, especially in Indonesian schools. It is necessary to develop a quality, and competitive Pencak Silat tradition that open to other cultures' society and become the main pillar of Indonesian culture that is recognized by the world as well (Catur Sutantri, 2018). The emphasize on the physical fitness is one of the reasons for the martial arts increase of popularity. Due to physical fitness has been the major issue of the current education (Studies et al., 2008). Pencak Silat learning is not only included as extracurricular activity, but it has been included in HPE learning to support a better improvement of the students' physical fitness.

However, teachers experience various difficulties in its implementation, especially on the mastery of the material. It is very important for teachers to master the learning material to help students learn the subject. Especially with the current dire situation that has made people around the world become aware of the current educational situation caused by the Covid-19 Pandemic (Martin et al., 2020). Currently, Information and Communication Technology is unavoidable in the globalized world and the development of literacy. Teacher plays a major role as a spearhead in education regarding the use of ICT in the teaching and learning process (kristanto, 2011; Nyagorme & Arkorful, 2022). To help make it easier for teachers to carry out their duties, it is very important for teachers to use learning aids in the form of learning media. On the other hand, learning resources for pencak silat are still limited, and the students were found struggling to find sources to solve the learning problems. Involving technology into learning is one of the appropriate solutions to this issue. It is important to immediately develop the media as a learning aid.

One of the ways to improve learning motivation using multimedia is by providing activities for the students (Surjono, 2017). The designing and development of learning media is crucial in providing students with learning resources (Alessi, 1991). Moreover, the designing of media also

determines the success of the product as expected by the developers. The learning contents need to be designed to sustain the improvement of students' motivation, self-confidence, physical competence, and knowledge and understanding (Durden-Myers et al., 2018).

Upon completing the initial design, it is important to develop the design by materializing it into a product of learning media. The product construction with a good foundation is expected to produce a good or quality product. The product quality needs to be identified immediately after the initial product is finished. Developers need to conduct evaluation. Several stages were conducted to identify the strength and weaknesses of the initial product and the effectiveness of the product. It can be said that identifying the product quality is very crucial to be conducted. Questionnaire was used in this study to collect the data in the testing stage to obtain the data on the product quality assessment and to identify the product effectivity.

The learning material application as a result of the present research and development is named MUKTI. This name, MUKTI, is an abbreviation from Multimedia Unik Kekinian dengan Teknologi dan Inovasi (Unique and Advanced Multimedia with Technology and Innovation). The initial product was evaluated by material experts, and the revised product was validated by the experts and was categorized as very good. It implied that the content of MUKTI Multimedia is appropriate and suitable to be used for learning by JHS students. Likewise, after the product was revised, the three media experts provided final assessment the MUKTI product assessment, and the result was categorized as very good. It implied that from the aspects of appearance and programming, the program was acknowledged to be very good. The product could be continued to be tested to potential users.

The data obtained from the testing were used to find out various kinds of weaknesses, deficiencies, or errors in constructing the product. The existing data would be used to revise the product before proceeded to the next stage. The testing was conducted to find out whether the product could later be used to achieve learning objectives (Sadiman et al., 2002). Formative evaluation was applied for the testing process in this study. Three stages of evaluation were conducted, namely the one to one, small group, and field evaluation. One to one testing involving 2-4 students, while small group involving 10-20 students, and field evaluation involving approximately 30 students in one class. The one to one evaluation resulted in very good scores in terms of appearance, material, and pedagogy. Then, the readability was also identified in this stage. In addition to the many positive comments, it was the first time that students received AR-based learning media and used it in HPE learning. The results of the one to one evaluation of all aspects were included in the very good category. MUKTI Multimedia was proven to be very well accepted. Applications were considered very fascinating and helped to understand the material. The similar case happened when evaluating a small group involving 10 students. All students provided a positive response. At the beginning, the students accepted MUKTI enthusiastically and were very interested to the product.

MUKTI application was considered very good as seen from the material, display, pedagogical and motivational aspects. The suggestions provided were used to revise the product. The field evaluation was attended by 30 students. Evaluation run naturally, similar with the normal learning situation. After receiving an explanation from the teacher, the students completed a pre-test, then studied the learning material with the help of MUKTI. Finally, students were given a product evaluation for their opinions about the product and students completed a post-test. Students attempted to learn to use the product and evaluated the understanding of the material. Students also provided feedback about the display, material, pedagogical and motivational aspects with very good results. Students then provided input, which included the students felt motivated and enthusiastic to learn pencak silat with the MUKTI application. Students were interested in the MUKTI application since this application was considered a new thing for students. With one display of the pencak silat movement, students could see it from various angles.

MUKTI application can be used by students as a learning medium and as resource that supports an understanding of pencak silat. Learning method with AR is efficient, especially to achieve better results in student's involvement in sports and progress in physical education (Liu et al., 2022). When students have a proper understanding, then they can practice better. Students obtain a clear understanding/instruction on how to perform the movements in pencak silat

practice. For a student to improve the performance of his motor skills, three factors must be kept in mind. First, students need a good understanding of the essential components of skills. Second, they need lots of opportunities to try out the skills. Last, frequent and appropriate feedback (Exercise) should be provided (Beseler & Plumb, 2019). The understanding of the movement become easier with the help of media. It is where the role of multimedia learning is needed to help understand the Pencaksilat material for junior high school students.

CONCLUSION

Multimedia development is crucial to help teachers and students in learning activities. The need for learning aids is very urgent, so that multimedia development is carried out in the form of a pencak silat learning application named MUKTI for junior high school students. The MUKTI application is a product of research and development of a unique, advanced pencaksilat learning multimedia with technology and innovation based on 3D Augmented reality for junior high school students. MUKTI's product has the advantage that one medium can be used to see a movement from various sides. In addition, downloading the application is very easy and only requires internet quota. Learning to use the MUKTI application has proven to be fun, effective, and well received by users. Learning using MUKTI application can cross the boundaries of time, place, and distance.

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