Digital-based pencak silat learning in Indonesia
Aprendizaje digital de pencak silat en Indonesia

Mulyana Mulyana, Sagitarius Sagitarius, Oktoviana Nur Ajid, Geraldi Novian
Universitas Pendidikan Indonesia (Indonesia)

Abstract. The use of digital technology has the potential to increase the effectiveness of learning both theoretical and practical materials with a wide range and not limited to space and time. This research aims to develop a digital-based learning model in the form of a website as a medium to improve the skills of the FPOK student athletes in *pencak silat*. The method used was research and development which consists of five stages, namely needs analysis, product design, product development, preliminary field test, operational field test (comparative test). The results of this research are web-based teaching materials. The design of digital teaching materials has been validated by lecturers of learning technology, and sports skills at UPI Bandung. The learning process increased in terms of mastery of *pencak silat* skills, exceeding the achievements of the direct teaching method.
Keywords: digital-based learning, pencak silat skills, product development

Resumen. El uso de la tecnología digital tiene el potencial de aumentar la eficacia del aprendizaje de materiales tanto teóricos como prácticos con una amplia gama y no limitada al espacio y al tiempo. Esta investigación tiene como objetivo desarrollar un modelo de aprendizaje basado en lo digital en forma de un sitio web como medio para mejorar las habilidades de los atletas estudiantes de FPOK en pencak silat. El método utilizado fue la investigación y el desarrollo que consta de cinco etapas, a saber, análisis de necesidades, diseño del producto, desarrollo del producto, prueba de campo preliminar, prueba de campo operativa (prueba comparativa). Los resultados de esta investigación son materiales de enseñanza basados en la web. El diseño de materiales de enseñanza digitales ha sido validado por profesores de tecnología de aprendizaje y habilidades deportivas en UPI Bandung. El proceso de aprendizaje aumentó en términos de dominio de las habilidades de pencak silat, superando los logros del método de enseñanza directa.
Palabras clave: aprendizaje basado en lo digital, habilidades de pencak silat, desarrollo de productos

Introduction

Digital learning is increasingly replacing traditional educational methods every day (Tashova, 2021). Especially after the spread of the corona virus, many educational institutions were closed to reduce transmission (Akram et al., 2021). As a response to this, UNESCO has recommended educational institutions to equip themselves with online learning tools (Joseph et al., 2020). Learning tools and technologies enable students to develop more effective independent learning skills (Tashova, 2021). The use of digital technology can also improve the teaching and learning process (Roschelle et al., 2008). In physical learning such as self-defense, tutorial virtual conferences can be a useful tool to bridge social distance and can continue physical learning of self-defense although in a different form (Kantzara & Loos, 2021). The martial arts learning process can be stimulated and supported by digital media (Hilvoorde & Pot, 2017; Novak et al., 2016; Van Hilvoorde & Koekoek, 2018). Therefore, it is hoped that under current conditions, digital-based learning will be very useful and effective when used as a learning medium in *pencak silat* martial arts. The reason is that although learning the techniques of *pencak silat* martial arts takes time and requires face to face meetings, the learning can be assisted by the use of digital learning media.

Previous research suggested that the competencies needed in digital learning include planning and organizing learning (Brady & Higgins, 2015). There are differences in the paradigms of learning patterns between leaning that uses and does not use technology and between the concept of learning in the classroom (classroom setting) and open learning or digital learning which does not always have to be in class (Purdy et al., 1992). Digital learning systems requires supporting infrastructure and technology, such as computers, internet access, servers, television, interactive video, CD/DVD ROM, and so on (Sife, A., Lwoga & Sanga, 2007). Digital learning includes aspects of hardware (infrastructure) in the form of computer sets that have the ability to transmit data, whether texts, messages, graphics, videos, or audios (Cothrel & Williams, 1999). With this capability, digital learning can be interpreted as a computer network that is interconnected with other computer networks throughout the world (Kitao & Kenji., 1998). Interconnected computers can create a sharing function which in simple terms can be referred to as a network (networking). The sharing function that is created through the network does not only include facilities that are needed and often needed, such as printers or modems, but also those related to data or certain applications or programs. Another progress related to digital learning as stated by (Kitao & Kenji., 1998) is that many computer terminals around the world are connected to digital learning, so that many people use digital learning every day. The advantage of digital learning is that it is an enjoyable medium, which creates learner interest in digital programs (Nana & Surahman, 2019). Other studies that discussed virtual technology in martial arts training provide many benefits and advantages. An example of unique research is on the role of digitization in the form of martial arts games in increasing the interest of the players to practice martial arts (Harper, 2013). Spreading martial arts in online media was able to increase the interest of the

audience to do the same activities, such as the parkour communities who upload their activities. Another example is the use of virtual reality simulation technology for dance practice. The research on judo sports branch in "Digital Tools in Service Competence Development" focused on the use of digital devices in developing service competencies and regards the digital training package format as a positive aspect (Mäki & Kokko, 2019).

This current research aims to solve practical learning problems in the sport of *pencak silat* by utilizing digital technology innovations. This is because reliability, availability, and security of the application are important elements in the process of digitizing education, and the user experience when accessing applications determines various technological innovations that can optimize the educational process. The authors conducted a search of research related to digital technology, especially for the learning process and has not found research that uses web-based learning media to assist the learning process of *pencak silat*. Therefore, the authors concluded that the research on *pencak silat* learning using web technology-based media is still original and has never been done.

Method

This research used the research and development (R&D) method conducted in 8 months. The research location was at the gymnasium of Universitas Pendidikan Indonesia. This research produced a learning aid for *pencak silat* martial arts in the form of visual digitization, with a focus on producing web-based teaching materials.

Research Sample

In the research and development, we selected samples purposively, namely students who were enrolled in the *Pencak Silat* course from the population of Sports Coaching Education Study Program, with a total of 104 students. Then, the samples were divided into two groups, namely the experimental group of 52 students who would carry out a preliminary field test by being given a *pencak silat* learning model using the developed product, and the control group of 52 students who would carry out an operational field test (comparison test), namely by being given a conventional learning model. The results from both groups were then compared.

Research Procedure

The research procedure refers to the research and development model of Borg and Gall (1983). The model consists of ten stages: (1) needs analysis, (2) planning, (3) product initial development, (4) preliminary field testing, (5) main product revision, (6) main area testing, (7) product revision, (8) operational field testing, (9) final product revision, and (10) socialization and implementation. However, this research only used five stages according to the needs, namely: (1) Needs analysis, (2) Product Design, (3) Product Development, (4) Preliminary Field Tests, (5) Operational Field Tests (comparison test).
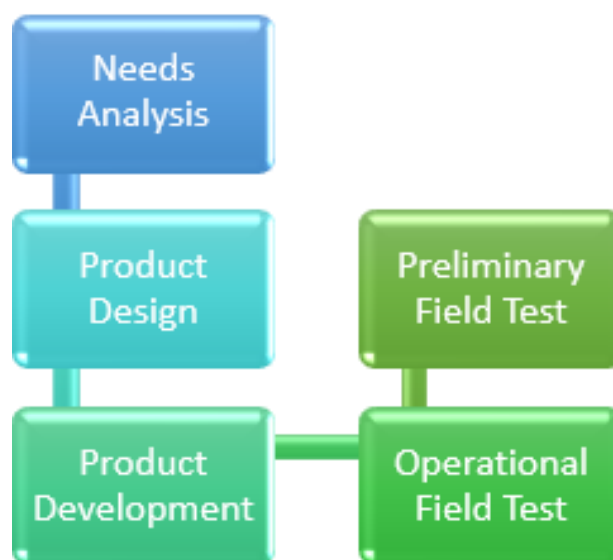

Figure 1. Flowchart of Research Stages

Needs Analysis

The Needs Analysis stage included product selection, literature review, and field observations regarding the concepts needed. At the beginning of the R&D activity, it was necessary to explain the product outline to be developed and the product tentative outline. The main focus in this analysis was finding solutions in distance learning for practical courses, especially *Pencak Silat*.

Product Design

At this stage, the researchers ensured that the purpose of the particular product or type of product was really suitable and could solve the problems and needs that had been determined at the need analysis stage. Cost estimates, labor, and product development time had to be as well designed as possible. Additionally, the design of the system to be built was also the main focus at this stage. The product design focused on use case diagrams which are divided into several components, namely use case diagrams of the administrator, lecturers, and students.

Product Development

The third stage, Development of Preliminary Product was done after the design activities are completed. At this stage preliminary product forms were developed and would be tested at a later stage. Detailed activities were carried out including drafts or product specific materials and evaluation tools. The product draft was produced to be finalized afterwards. Furthermore, this stage produced several interfaces from the product design such as log in pages, dashboard pages, registered course pages, student score report pages, quiz pages, and add new courses pages.

Preliminary Field Test

Preliminary field tests were conducted on the experimental group of 52 students who were given a *pencak silat* learning model using the developed product. The purpose of the preliminary field trial was to directly test the results

of the product. Then, the results of this trial would undergo analysis of the results, whether the results that students obtained lead to a good understanding in the learning process of the pencak silat course.

Operational Field Test (comparison test)

The operational field tests were carried out in a control group of 52 students, namely by giving a conventional learning model. The results of the test were then compared with the results from the experimental group. The goal of the operational field testing was to ensure that the product was completely ready for use in the field without the presence of developers or staff. To achieve this condition, the product had to be thoroughly tested in every aspect. The operational field tests were directed at activities that are similar to regular learning. At this stage, the results of the experimental group and the control group were compared, with a focus on determining the level of effectiveness of the learning model using the digital-based pencak silat learning development product or conventional pencak silat learning model.

Data Collection

The treatment given was pencak silat course material that had been arranged in the syllabus and lesson plans delivered with a duration of 2 x 50 minutes for each meeting. However, the materials were differentiated, as the experimental group was given the web-based Learning Model System (LMS) method from "m-silatupi.com" and the control group was given conventional methods. The instrument for measuring the results of the treatment were theoretical tests related to the materials that have been given then accumulated with practical tests in the mastery of the Pencak Silat Movement Techniques that were taught during the treatment.

Data Analysis Technique

The analysis design to test the effectiveness of digital learning model products used empirical experiments. The experimental design uses the quasi-experimental method (nonrandom assessment), with the type of Alternative Post-Test Treatment Non-Equivalent Design (Alternative Treatment Post-Test Only with Nonequivalent Groups Design) (J. Creswell, 2013).

Findings and discussion

Findings
Analysis and Design

This section discusses the analysis of procedures and flow of documents which are described in the form of flowcharts, coding and analysis of non-functional systems which include hardware and software used, as well as analysis of users involved in the system. This analysis section is divided into two parts, namely the ongoing analysis and the analysis of the system to be built.

Analysis

The ongoing analysis was conducted during the teaching and learning activities in which the lecturer was present in class to provide lecture materials to the students. It was a virtual class using the application that we had designed and developed. This application could be accessed by all students who enrolled the pencak silat martial arts sports course, which was developed based on a web-based LMS. This was intended so that the problems that have been mentioned in the introduction section were answered, namely that student with athlete status, who were enrolled in the pencak silat course but could not attend lectures due to because they have to take part in the TC (Training Center) in each of their respective sports, can continue studying. The steps that will be taken are as follows:

a) Lecturers come to class and teach or provide materials to the students.

b) The students who are taught by the lecturer record or take notes of the lecture materials.

c) The lecturers give assignments to the students.

d) The students work on the assignments given by the lecturers.

e) The lecturers give quizzes to students.

f) The students work on quizzes given by the lecturers.

g) The lecturers give final scores or accumulated grades for quizzes and assignments to the students.

h) The students receive the final score from the lecturers.

Analysis of the system to be built

The steps that will be taken to analyze the system to be built are as follows:

a) The admin logs in to the system.

b) The system will verify, if it fails, it returns to log in.

c) If successful, the admin will enter course data and student data into the system.

d) Course data and student data will be stored by the system.

e) The lecturer logs into the system.

f) The system will verify, if it fails it returns to log in.

g) If successful, the lecturer will enter assignment data, quiz data and upload material into the system.

h) Assignment, quiz, and material data will be stored by the system.

i) The students log in to the system.

j) The system will verify, if it fails it returns to log in.

k) If successful, the students will download the material, send assignments and quizzes.

l) The system will store data on student assignments and quizzes that have been done.

m) Complete.

Design

Design is the depiction, planning, and sketching or arrangement of several separate elements into a unified whole. This stage includes configuring the software and hardware components of a system.

Use Case Diagram

Use case diagram is a construction to describe the relationships that occur between actors and activities contained in the system. The goals of use case modeling include defining the functional and operational requirements of the system by defining the usage scenarios that are agreed upon between the user and the developer. From the analysis of existing application users, the use case diagram for the system was designed.

Admin's Use Case Diagram

Admin has a very complex role in its use including:
a) Log in.
b) Edit admin profile.
c) User management to manage user data such as adding users and deleting users.
d) Course management to manage course data.
e) Features management to provide quizzes, assignments, materials, and videos to student users.

Lecturer's Use Case Diagram

The role of lecturers in the system is:
a) Log in.
b) Edit the lecturer's profile.
c) Course management to manage course data that will be given to students.
d) Features management to provide quizzes, assignments, materials, videos to students.

Student's Use Case Diagram

The role of students in the system is:
a) Log in.
b) Edit student profile.
c) Student features, the function of this feature is to do quizzes, do assignments, open material and watch videos given by the lecturers.

The Results of Product Interface Development

Log In Page

This page contains a username and password form that functions to input in the registered user username and password. The 'Log in' button functions to enter the system, and the 'Log in as a guest' button functions to enter the system for users who are not registered or as guests. This page can be accessed by the administrators, lecturers, and students.

Dashboard Page

This page serves as the main interface displaying courses that have been recently accessed by the user. This page can only be accessed by student users.

Registered Course page

This page contains any courses that the user is registered in. This page can only be accessed by student users.

Student Score Report page

This page contains a report on the scores of the courses that students the students are registered in. This page can be accessed by administrators, lecturers, and students.

Quiz page

This page contains quiz questions given by lecturers to students. This page can be accessed by administrators, lecturers and students.

Add New Course Page

This page functions to add new courses. This page can be accessed by administrators and lecturers.

Limited Test (Experimental) Results

Based on limited tests in the experimental group, the following data were obtained:
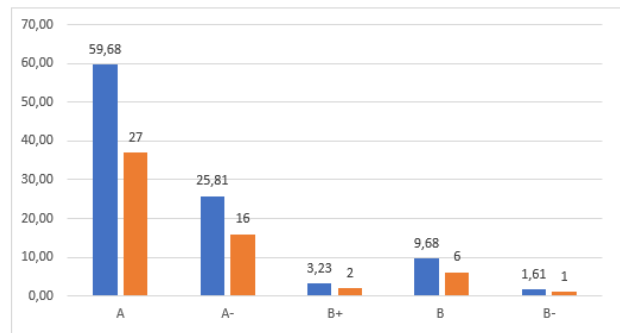

Figure 2. Experimental Group Field Test Results on Learning Outcome Distribution of Pencak Silat Skills

Based on Figure 2, very effective learning results were obtained, with 27 students or 60%obtaining A, excellent (4.0,), 16 students or 25.8%obtaining A-, nearly excellent (3.7), 2 students or 3.23%obtaining a very good score (3.4), 6 students or 9.68%obtaining a good score (3), and 1 student or 2.7%obtaining a fairly good score (2.7) (2015 UPI Education Implementation Guidelines).

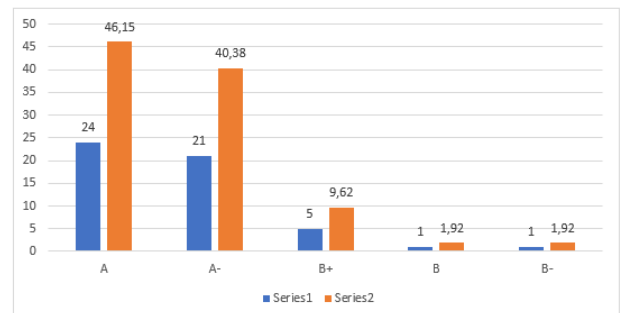**Comparative Trial Results (Control)**

Figure 3. Control Group Field Test Results on Learning Outcome Distribution of Pencak Silat Skills

Figure 3 shows the learning results of the control group,

namely the group that used direct teaching or did not use digital-based learning. Of the 52 participants, 24 students or 46.15%obtained an A (excellent), 21 students or 40.38%obtained an A- (almost special) score, 5 students or 9.62%obtained a B+ score (very good), 1 student or 1.92%obtained a B (good), and 1 student or 1.92% obtained a B- (fairly good). When the percentage of scores were compared, in the excellent score category, the experimental group gained 60%, larger than the control group which was 46.15%. In the nearly excellent score category, the experimental group gained 25.81%, smaller than the control group which was 40.38%. In the very good score category, the experimental group gained 3.23%, smaller than the control group which gained 9.62%. In the good score category, the experimental group gained 9.68%, larger than the control group namely 1.92%. In the fairly good category, the experimental group gained 1.61%, smaller than the control group which gained 1.92%. It can be concluded that web-based learning for learning outcomes of *pencak silat* skills was more effective than direct learning.

Discussion

This research succeeded in creating an LMS learning model or digital-based learning. This product was quite effective for use in the learning process of *pencak silat* at the Sports and Health Education Faculty (FPOK, *Fakultas Pendidikan Olahraga dan Kesehatan*). Overall, the learning process could take place online and students were able to follow and complete all learning materials properly. Moreover, in this research, the data obtained from the tests were limited in scope. Based on the test results, it was found that digital-based learning was effective in the learning of *pencak silat*. Similar research has also been done to develop interactive multimedia teaching materials in the *pencak silat* coursev (Angga et al., 2020). In their research (1) the develop product, in the form of interactive multimedia using CourseLab 2.4 software, was used to compile powerful and easy-to-use e-Learning-based multimedia teaching materials (e-learning authoring tools); and (2) it was concluded that the development of interactive multimedia teaching materials for the *pencak silat* course could help improve conceptual understanding and improve the basic technical skills of *pencak silat*. The similarity of the research results is found in the application of Android-based Three-Dimensional Website (Web3D) technology as a medium for learning the basic movements of silat. This interactive multimedia could help fighters remember *silat* movements and overcome the shortage of books. In terms of technological acceptance of the use of Web3D technology, 86% users agreed that the learning media was useful, 85% users agreed that the media was easy to use, 86% users agreed that they intended to use the media, and 78% users felt hesitant to actually use the 3D Silat Learning Media (Rahmanto & Yuda Utama, 2018). The results of other studies also show that interactive multimedia teaching materials have a significant effect on

improving learning outcomes in the theory and practice of martial arts courses (Suwiwa et al., 2014). Currently, many interactive multimedia for pencak silat have been developed (Istiqomah, 2014);(Saputro, 2018);(Setiawan, 2015);(Suwiwa et al., 2014);(Syah, 2017), for example the use of CourseLab 2.4 has been proven to effectively improve the learning process, and it was used in the development of course teaching materials for martial arts for students of Malang State University (Mubarok, 2016).

In line with the research results, previous research used digital technology in physical education learning such as the application of learning videos conducted in elementary schools (O'Loughlin et al., 2013). Video technology was effective in increasing engagement in learning and demonstrating a level of commitment such as helping other students to develop technical understanding. In addition, it was found that students felt motivated and it allowed them to be more engaged in learning (Casey & Jones, 2011). Similar results were also found by (McKethan & Everhart, 2000), who conducted research in elementary schools showing significant differences in results between the conventional group and the multimedia group in improving the skills component. Research has shown that similar technologies, such as video-based instruction, have significant success in physical education (Morrison & Reeve, 1989). It was also found that the development of motor skills physical prowess and assessment of motor skills could be improved by using interactive video discs. In chemistry courses, digital-based learning could improve student learning outcomes. The effect of digital-based learning strategies on student learning outcomes was 52.8%. This showed that digital-based learning strategies could improve student learning outcomes in organic chemistry courses which in turn could increase the achievement of chemistry learning outcomes (Wijayati et al., 2019). Thus, technology in learning has conceptually contributed to learning activities in the form of problem-solving knowledge, increasing student motivation, and enriching learning resources that can be obtained quickly. Digital-based (online) learning can have a positive effect in overcoming the challenges of education in Indonesia (Widiara, 2018). In terms of the assessment of the development of a digital-based assessment modelwas carried out in Australia. An integrated and practical computer-based assessment component was designed and adapted to manage a variety of physical activities and was successfully implemented in schools. Students found the assessment process to be very authentic and meaningful in the field of Physical Education Studies, in which 'practical' and 'theoretical' aspects were integrated into the assignments. This assessment provided a valid assessment tool related to aspects of students' skills, knowledge, and understanding (Penney et al., 2012).

In the area of learning methods, the digitalization of education has led to new learning methods which facilitate lecturers and students to have enthusiasm and interest in the learning process. The results showed that the use of GeoGebra assisted by e-learning was effective in improving

student learning outcomes in the concept of fields and lines in space. This can be observed from the majority of students obtaining maximum learning outcomes, and only a small number of students whose learning outcomes were still minimal. This research recommended using GeoGebra and e-learning in learning other geometric concepts (Sudihartinih & Wahyudin, 2019). Changes also occurred in the learning process because it does not have to go be face-to-face. In traditional learning, the learning process is delivered only face-to-face, but with advances in technology, the learning process does not have to bring together lecturers and students, but can also use digital applications. This will create student independence during the learning process (Andalas & F, 2020). The assessment aspect has also changed, namely with the existence of an assessment data processing system that uses technology, the process is faster and more accurate. Manual analysis certainly makes the learning time longer. However, after the digitization of education, all tasks have become easy to do. This is also true in practical learning, such as the application of sports teaching platforms in universities. That the use of SOA technology is an effective way to build a sports network education digital platform in colleges and universities (Brown, 2015).

Due to advances in technology, new methods have been created that enable students to understand abstract materials, because these materials can be easily understood by students with the help of technology. Implementing and using information sensors, robotic motion data, and hand movements monitored in collaborative workspaces, enables live experimentation and facilitates effective empirical learning processes (Komenda et al., 2019). Therefore, the complexity of using digital technology seems to be one of the contributing factors (Wijekumar et al., 2006). The above research results have been proven in digital-based learning research, in learning the traditional martial arts of *pencak silat* at the Indonesia University of Education (UPI). *Pencak silat* as a game (expertise) in self-defense with the dexterity to parry, attack, and defend oneself. Technically, the basic skills of pencak silat are very complex (Mulyana, 2013). The complexity of learning *pencak silat* is not easy to teach students, especially those who are new to pencak silat. Moreover, student athletes have limited opportunities to attend lectures. Therefore, innovation in presenting digital-based *pencak silat* learning materials is absolutely needed, especially in the midst of the current pandemic era. The presentation of digital-based learning is not only carried out via the web, but is also packaged in videos that are interactive and easy to follow. The use of the web (e-Learning) in learning *pencak silat* has made it easier for students to overcome difficulties in learning complex movement skills so that they become more concrete, thus having an impact on increasing student understanding. (Munir, 2017) stated some of the advantages of e-Learning: (1) It provides a high stimulus for learning interactions.

E-Learning which is built and used carefully can improve learning interactions between educators and students as well as the teaching materials delivered; (2) It provides convenience in learning interactions, not limited by space and time. Students can access the learning materials available in the system, whenever they can and wherever they are, because the learning materials have been packaged in electronic form; (3) It provides a wide range of effects. The flexible nature of e-Learning in terms of space and time provides an effect that can be reached by students through online learning. Place and time are no longer an obstacle for students who want to study but not having enough time; and (4) The learning materials can be easily updated and stored. E-Learning facilitates material updates that can be done in a structured and timed manner easily. In addition, e-Learning provides convenience in terms of storing learning materials in the system, so students can easily reopen learning materials that they want to repeat in understanding them. (Darmawan & Bariyah, 2015) added that there are three functions of e-Learning in teaching and learning activities: (1) It functions as a supplement as students have the freedom to choose teaching materials contained in e-Learning. There is no obligation for students to use e-Learning materials. Even though it is only optional, students who use e-Learning will definitely have additional knowledge; (2) It functions as a complement as the teaching materials in e-Learning are used to complement the learning materials that students receive in class, which means that the material in e-Learning is programmed to become reinforcing material or repetition material for students; (3) It functions as a substitution. Many developed countries provide learning alternatives to their students, with the aim that they are more flexible in managing class schedules according to the time and daily activities of students. The emergence of the digital era in the world of education has become a source of knowledge and information center in education (Kusnandi, 2019)

Conclusion

The use of digital-based learning technology makes the learning process of *pencak silat* more efficient, especially for students with athlete status who cannot attend face-to-face classes. The effect of digital-based learning strategies on student learning outcomes was higher than face-to-face classes. This shows that the existence of a digital-based learning strategy can improve student learning outcomes which in turn can increase the achievement of learning outcomes for *pencak silat*. Based on the test results data, there was an increase in ability with the use of digital-based teaching media, amounting to 59.68% compared to conventional learning 46.15%. Reports on student evaluation results in each semester made it easier and faster to see the results. Student responses in digital-based learning through the use of video media showed positive responses, which were also evidenced by the increasing students activities in each lesson.

Acknowledgments

involved and supported this research.

References

Akram, S., Azhar, M. M., Basit, A., Ul Haq, M. I., & Waris, M. (2021). Pandemic Covid-19: Comparative Study of Social and Scientific Developments By Punjab and Sindh Governments in Pakistan. *Humanities & Social Sciences Reviews*, *9*(2), 429–439. https://doi.org/10.18510/hssr.2021.9242

Andalas, & F, E. (2020). *Digitalisasi Dunia Pendidikan? Humanisme Digital sebagai Poros Pembangunan Manusia. Membangun Optimisme Meretas Kehidupan Baru dalam Dunia Pendidikan*.

Angga, P. D., Hariyanto, E., & Tomi, A. (2020a). Pengembangan Bahan Ajar Multimedia Interaktif Pencak Silat Berbasis CourseLab. *Jurnal Pendidikan Jasmani Indonesia*, *16*, 9–17.

Angga, P. D., Hariyanto, E., & Tomi, A. (2020b). Pengembangan Bahan Ajar Multimedia Interaktif Pencak Silat Berbasis CourseLab 2.4. *Jurnal Pendidikan Jasmani Indonesia*, *16*(1), 9–17. https://doi.org/10.21831/jpji.v16i1.29285

Brady, A., & Higgins, R. M. (2015). Creative Excellence in the Japanese University: Knowledge-Content-Cognition and Language-Culture-Communication Integrated Global Awareness Learning. *Creative Education*, *06*(21), 2283–2298. https://doi.org/10.4236/ce.2015.621236

Brown, J. P. (2015). Complexities of digital technology use and the teaching and learning of function. *Computers & Education*, *87*, 112–122.

Casey, A., & Jones, B. (2011). Using digital technology to enhance student engagement in physical education. *Asia-Pacific Journal of Health, Sport and Physical Education*, *2*, 51–66.

Cothrel, J., & Williams, R. L. (1999). On-line communities: helping them form and grow. *Journal of Knowledge Management*.

Crawford, J., Butler-Henderson, K., Rudolph, J., Malkawi, B., Glowatz, M., Burton, R., Magni, P. A., & Lam, S. (2020). COVID-19: 20 countries' higher education intra-period digital pedagogy responses. *", Journal of Applied Learning and Teaching*, *3*, 1.

Creswell, J. (2013). Steps in Conducting a Scholarly Mixed Methods Study. *Steps in Conducting a Scholarly Mixed Methods Study*, 1–54. https://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1047&context=dberspeakers

Creswell, J. W. (2013). *No Title*.

Crys. (1997). Creative Excellence in the Japanese University: Knowledge-Content-Cognition and Language-Culture-Communication Integrated Global Awareness Learning. *Creative Education*, 17–35.

Darmawan, D., & Bariyah, S. H. (2015). Pengembangan E-Learning Berbasis Moodle dan Facebook Pada Mata Pelajaran Tik. *Jurnal Teknodik,* 227–240.

Harper, T. (2013). *The Culture of Digital Fighting Games* (1st Editio). https://doi.org/https://doi.org/10.4324/9780203566275

Hilvoorde, I. van, & Pot, N. (2017). *Embodiment and fundamental motor skills in eSports* (1st Editio). In Sport and Play in a Digital World.

Istiqomah, S. (2014). Pengembangan Multimedia Interaktif Pembelajaran Pencak Silat. *Skripsi Jurusan Pendidikan Jasmani Dan Kesehatan, Fakultas Ilmu Keolahragaan, .*

Joseph, C., Kerryn, B., Jürgen, R., Bashar, M., Matt, G., Paola, A. M., & Sophia, L. (2020). Journal of Applied Learning & Teaching COVID-19 : 20 countries ' higher education intra-period digital pedagogy responses. *Journal of Applied Learning & Teaching*, *3*(1).

Kantzara, V., & Loos, M. (2021). Maintaining Close Contact From a Distance: Digital Aikido Training Under Covid-19 Conditions. *Martial Arts Studies*, *2021*(11), 32–45. https://doi.org/10.18573/mas.128

Kitao, & Kenji. (1998). Internet Resources Related to Communication. *Learning Media Of Applications Design Based Android Mobile Smartphone*, 6576–6585.

Komenda, T., Reisinger, G., & Sihn, W. (2019). A Practical Approach of Teaching Digitalization and Safety Strategies in Cyber-Physical Production Systems. *Procedia Manufacturing*, *31*, 296–301.

Kusnandi. (2019). *Mengartikulasikan Perencanaan Pendidikan Di Era Digital*. 6, 5–10.

Mäki, M., & Kokko, T. (2019). Digital Tools in Service Competence Development — Case: Learning Verbal Judo Digitally. *Journal of Service Science Research*, *11*(1), 69–91. https://doi.org/10.1007/s12927-019-0004-7

McKethan, R. &, & Everhart, B. (2000). The effects of a multimedia computer program on preservice elementary teachers' knowledge of cognitive components of movement skills. *The Physical Educator*, *57*, 58–68.

Morrison, C., & Reeve, J. (1989). Effect of different videotape instructional units on undergraduate physical education majors' qualitative analysis of skill. *Perceptual and Motor Skills*, *69*, 111–114.

Mubarok, K. (2016). Pengembangan Media Pembelajaran Interaktif Menggunakan Software Courselab Pada Kompetensi Kejuruan Teknik Listrik di SMKN 2 Surabaya. *Jurnal Pendidikan Teknik Elektro*, *5*, 7.

Mulyana, P. P. S. (2013). *Membangun Jati Diri Dan Karakter Bangsa. Bandung: Remaja Rosdakarya*.

Munir. (2017). *Pembelajaran Digital*.

Mutia, U., & Rusman, M. P. (2018). *ANALISIS KURIKULUM BERBASIS PEMBELAJARAN DIGITAL PROGRAM STUDI MANAJEMEN BISNIS TELEKOMUNIKASI DAN INFORMATIKA*.

Nana, N., & Surahman, E. (2019a). *Pengembangan Inovasi Pembelajaran Digital Menggunakan Model Blended POE2WE di Era Revolusi Industri 4.0. In Prosiding SNFA (Seminar Nasional Fisika dan Aplikasinya)*. 82–90.

Nana, N., & Surahman, E. (2019b). Pengembangan Inovasi

Pembelajaran Digital Menggunakan Model Blended POE2WE di Era Revolusi Industri 4.0. *Prosiding SNFA (Seminar Nasional Fisika Dan Aplikasinya)*, *4*, 82. https://doi.org/10.20961/prosidingsnfa.v4i0.35915

Novak, D., Antala, B., & Knjaz, D. (2016). Physical education and new technologies. *Zagreb: Croatian Kinesiology Association*, *December*. http://e-biblio.univ-mosta.dz/bitstream/handle/123456789/3453/FIEP book -2016.pdf?sequence=1&isAllowed=y#page=195

O'Loughlin, J., Chróinín, D. N., & O'Grady, D. (2013). Digital video: The impact on children's learning experiences in primary physical education. *European Physical Education Review*, *19*(2), 165–182. https://doi.org/10.1177/1356336X13486050

Penney, D., Jones, A., Newhouse, P., & Cambell, A. (2012). *Developing a digital assessment in senior secondary physical education. Physical Education and Sport Pedagogy*. *17*, 383-410.

Purdy, James, & Wright, C. (1992a). . Cabot Wright Begins. *New York: LIverlight*.

Purdy, James, & Wright, C. (1992b). *Cabot Wright Begins*. LIverlight.

Rahmanto, Y., & Yuda Utama, R. (2018). Penerapan Teknologi Web3D Berbasis Android Sebagai Media Pembelajaran Gerakan Dasar Silat. *Technology Acceptance Model*, *9*(1), 7–14.

Roschelle, J., Tatar, D., Shechtman, N., & Knudsen, J. (2008a). The role of scaling up research in designing for and evaluating robustness. *Educational Studies in Mathematics*, *68*, 149–170.

Roschelle, J., Tatar, D., Shechtman, N., & Knudsen, J. (2008b). The role of scaling up research in designing for and evaluating robustness. *Educational Studies in Mathematics*, *68*(2), 149–170. https://doi.org/10.1007/s10649-008-9119-3

Saputro, G. E. (2018). Pengembangan Media Pembelajaran Berbasis Modul Tutorial Pada Mata Pelajaran PJOK Materi Pencak Silat Kelas XI di SMK Ngunut Kabupaten Tulungagung. *[Skripsi]. Universitas Nusantara PGRI Kediri.*

Setiawan, A. D. (2015). Pengembangan Multimedia Pembelajaran Pencak Silat Pendidikan Jasmani, Olahraga dan Kesehatan Berbasis Adobe Flash CS3 Profesional untuk SMP Kelas VII [Skripsi]. *Prodi Pendidikan Jasmani Kesehatan Dan Rekreasi Jurusan Pendidikan Olahraga Fakultas Ilmu Keolahragaan Universitas Negeri Yogyakarta.*

Sife, A., Lwoga, E., & Sanga, C. (2007). New technologies for teaching and learning: Challenges for higher learning institutions in developing countries. *International Journal of Education and Development Using ICT*, *3*(2), 57–67. https://doi.org/10.1109/MEMB.1985.5006222

Sudihartinih, E., & Wahyudin, W. (2019). Pembelajaran Berbasis Digital: Studi Penggunaan Geogebra Berbantuan E-Learning Untuk Meningkatkan Hasil Belajar Matematika. *Jurnal Tatsqif*, *17*, 87–103.

Suwiwa, I. G., Santyasa, I. W., & Kirna, I. M. (2014). Pengembangan Multimedia Interaktif Pembelajaran pada Mata Kuliah Teori dan Praktik Pencak Silat. *E-Journal Program Pascasarjana Universitas Pendidikan Ganesha Program Studi Teknologi*.

Syah, V. Z. F. (2017). *Aplikasi Pembelajaran Interaktif Pencak Silat Persaudaraan Setia Hati Terate Berbasis Mobile [Skirpsi]*.

Tashova, Z. M. (2021). Benefits Of Digital Learning Over Traditional Education Methods. *Scientific Journal Impact Factor*, *1*(4), 423–427.

Van Hilvoorde, I., & Koekoek, J. (2018). Digital technologies: A challenge for Physical Education. *Changes in Childhood and Adolescence: Current Challenges for Physical Education*, *December*. https://www.researchgate.net/publication/328768497

Widiara, I. K. (2018). Blended Learning sebagai Alternatif Pembelajaran di Era Digital. *Purwadita: Jurnal Agama Dan Budaya*, *2*, 50–56.

Wijayati, N., Kusuma, E., & Sumarti, S. S. (2019). Pembelajaran Berbasis Digital Di Jurusan Kimia Fmipa Unnes. *Jurnal Inovasi Pendidikan Kimia*, *13*.

Wijekumar, K. J., Meyer, B. J. F., Wagoner, D., & Ferguson, L. (2006). Technology affordances: The "'real story'" in research with K-12 and undergraduate learners. *British Journal of Educational Technology*, *3*, 191–209.

Datos de los/as autores/as y traductor/a:

Mulyana Mulyana	mulyanafpok@upi.edu	Autor/a
Sagitarius Sagitarius	sagitarius@upi.edu	Autor/a
Oktoviana Nur Ajid	oktoviananurajid@upi.edu	Autor/a
Geraldi Novian	geraldi.novian@upi.edu	Autor/a
Ira Purnamasari	irapurnamasari@upi.edu	Traductor/a