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Unveiling technology's integral role in pencak silat: A systematic literature review

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ABSTRACT

Background Problems: Over the past decade, research on technology in Pencak Silat has grown rapidly. However, the literature review on this topic was very limited. **Research Objectives**: The purpose of this paper is to conduct an in-depth systematic literature review on the role of technology in the development of Pencak Silat. **Methods**: Two databases (Scopus and Web of Science) were used to select articles containing information on this topic. The search was conducted following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. After the exclusion criteria, only 14 articles were categorised. **Findings and Results**: Results from the analysed literature showed the positive impact of various technologies on the learning of Pencak Silat and improvements in training and sporting events. The application of technologies such as interactive multimedia, Android applications, augmented reality (AR), and virtual reality (VR) has been shown to improve students' understanding and achievement in understanding the basic and complex movements of Pencak Silat. Likewise, in the world of sports, technologies such as RFID, fuzzy logic, the Internet of Things (IoT), 3D motion capture, sensors, and VR have changed the way training and scoring in Pencak Silat matches were conducted. **Conclusion**: Technology has played a key role in improving Pencak Silat education and the sport of Pencak Silat. It has brought significant changes in the way movements are understood, training is conducted, and judgement is made. With wise use, technology continues to open up opportunities to better understand Pencak Silat and improve the quality of learning and competition.

Keywords: Technology; pencak silat; review; scopus; wos

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INTRODUCTION

Pencak Silat, as a traditional martial art with roots in the archipelago, is not only part of Indonesia's cultural heritage (Ediyono & Widodo, 2019), but has also permeated the lives of its Southeast Asian neighbours (Abdul et al., 2022; Syaifullah et al., 2023). Its rich and diverse history has propelled Pencak Silat to become not just a martial art but also a profound expression of culture (Kusumo & Lemy, 2021; Sampurna et al., 2021). Pencak

Silat has grown to be more than just a physical movement; it is a symbol of identity and heritage that is preserved from generation to generation (Ediyono & Widodo, 2019). However, in the face of ever-evolving times, technology-based changes have become inevitable, and Pencak Silat has had to adapt. Technology has played an increasingly important role in the development of Pencak Silat, influencing teaching methods, practices, and community perceptions (Ihsan et al., 2017).

The use of technology in martial arts, especially in the context of Pencak Silat, is an interesting phenomenon that raises essential questions about its impact on the tradition and development of the sport. In this digital era, technology has enabled the dissemination and documentation of Pencak Silat through various media, such as online videos, websites, and mobile applications (Mardius et al., 2023; Raibowo et al., 2023). These media platforms have been utilised to share and preserve Pencak Silat knowledge, bridge the gap between generations, and assist in maintaining cultural heritage. In addition, technology is also used in the training and assessment of Pencak Silat athletes (Anifah et al., 2022; Ng & Jumadi, 2022; Soh et al., 2015), creating substantial changes in the way athletes and coaches prepare for and compete in the international arena.

In the context of the evolution of Pencak Silat, various applications have emerged that are specifically designed to support Pencak Silat training and learning. For example, some smartphone apps allow athletes and coaches to record and analyse their own movements during training (Lubis et al., 2022), and mobile apps can improve students' understanding and competence in Pencak Silat (Riyadi et al., 2023; Sumarno et al., 2020). Such apps are often equipped with intelligent algorithms that enable movement recognition and instant feedback. This allows athletes to identify their technical errors and correct them more efficiently. In addition, some other apps have been designed to stimulate competition and athlete development through online tournaments or score comparisons (Anifah et al., 2023, 2021). Such technologies create new opportunities for the Pencak Silat community to engage in international competitions without the need to move, while popularising the sport.

Over the past decade, research into technology in Pencak Silat has grown rapidly. These studies are generally empirical in nature, utilising methods such as 3D motion capture (Soh et al., 2015), sensor technology (Ihsan et al., 2017), and augmented reality (AR) (Muktiani et al., 2022; Nelson et al., 2022). However, the literature review on this topic is very limited, and only one study conducted by Saputro et al. (2021) exists. The literature review was limited to covering software development in Pencak Silat and utilised only one database (SINTA). There has been no systematic effort to examine the role of technology in Pencak Silat by utilising two leading journal databases, namely Scopus and WoS. Therefore, this knowledge gap is an important reason why this study needs to be conducted. With the evolving role of technology in sport and the paradigm shift faced by the Pencak Silat community in the digital era, this study becomes highly relevant and urgent.

Therefore, the main objective of this paper is to conduct an in-depth systematic literature review on the role of technology in the development of Pencak Silat. We explored how technology has influenced various aspects of Pencak Silat, from teaching methods to competition evaluation. We also assessed the positive and negative impacts of technology on maintaining the integrity and traditional values of Pencak Silat. Through a systematic literature review approach, this paper presented relevant research results and key findings relating to the role of technology in the context of Pencak Silat. In doing so, we hope that this contribution will encourage further discussion on the relationship between tradition and technology in the martial arts world, highlighting the challenges and opportunities that arise. Finally, it is hoped that this paper will provide guidance for policymakers, instructors, and Pencak Silat practitioners to address the challenges and opportunities that exist in integrating technology with this tradition.

METHOD

Search Strategy

The search was initiated using the Scopus and Web of Science (WoS) databases, both considered the leading indexing systems for citations (Farid et al., 2020), and frequently visited by previous researchers worldwide (Perdima et al., 2022; Sweileh, 2020; Yang et al., 2021). The search strategy included a combination of keyword variations ("pencak silat" OR "silat") AND ("technology" OR "software technology"

OR “internet of things” OR “artificial intelligence” OR “virtual reality” OR “augmented reality” OR “android”). Commencing on November 1, 2023, the search aimed to identify articles within the last 5 years (2019–2023) that met the inclusion criteria. The search was conducted following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Shaffril et al., 2019). Additionally, PRISMA emphasises review reports that evaluate randomised trials, which can serve as a basis for reporting systematic reviews across various types of research (Sarkis-Onofre et al., 2021).

Exclusion Criteria

The exclusion criteria used were as follows: (1) articles that were duplicated; (2) articles that were not published in journals indexed in Journal Citation Report (JCR) or Scimago Journal Rank (SJR); (3) articles in languages other than English; (4) journal articles with selected empirical data, meaning review articles, book series, books, and chapters in books were all excluded; and (5) articles that did not explicitly mention technology in martial arts.

Procedure

From the search results, 27 publications were obtained from two databases: WoS (7 articles) and Scopus (21 articles). After following the exclusion criteria, only 14 articles remained. Most of the items were discarded because the articles did not mention technology in Pencak Silat. All articles were extracted from the database and analysed through Mendeley software to remove duplicate articles.

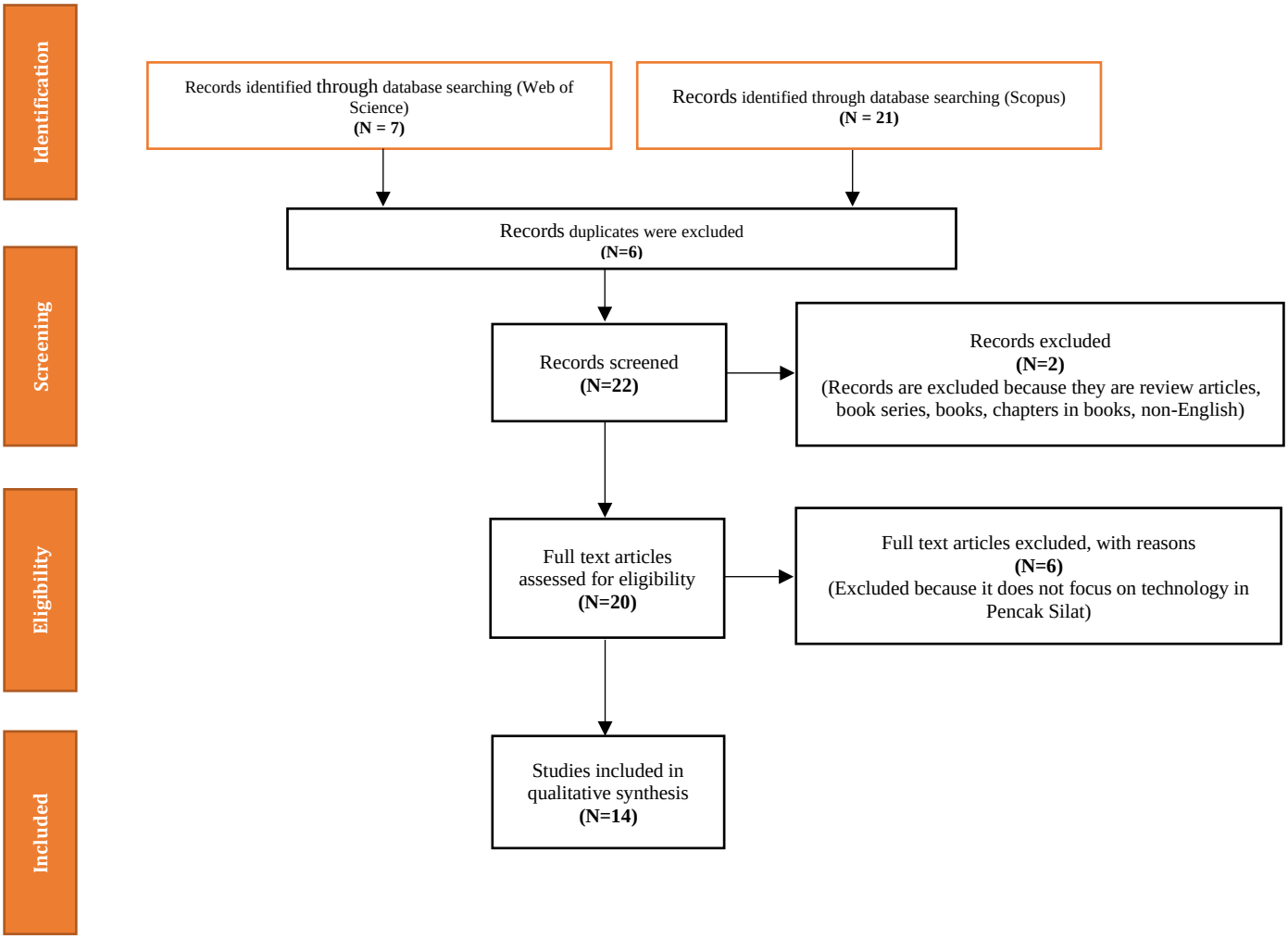

Figure 1. The Flow Diagram of the Study
(Adapted from Shaffril et al., 2019).

RESULTS AND DISCUSSION

The six categories listed in Table 1 (except author and year) are described and discussed in the 14 articles.

Table 1. Summary of Article on Technology in Pencak Silat

Author and Year	Country	Methods	Purpose	Outcomes	Sources
(Lanos, Ihsan, Okilanda, Handayani, Manullang, & Hikmah, 2023)	Indonesia	Experimental Research	To get the effectiveness of interactive multimedia using jurus tunggal tangan kosong that supported physical education.	Interactive multimedia presentations are effective in improving mastery of single hand-to-hand moves.	International Journal of Human Movement and Sports Sciences (Scopus)
(Anifah, Zuhrie, Muhammad, & Haryanto, 2023)	Indonesia	Hardware and Software Design	To propose a solution that can be used as a support system to calculate Pencak Silat scores in real-time and Internet of Things (IoT) based.	The experimental results show that the use of a system equipped with RFID has higher accuracy in determining the score, namely 99.8% in identifying punches, while the accuracy in identifying kicks is 99.4%. The AUC value generated by the first system is 0.996 in identifying punches, and 0.944 in identifying kicks.	International Journal on Technical and Physical Problems of Engineering (Scopus)
(Yudaparmita, Kanca, Sudiana, & Dharmadi, 2023)	Indonesia	Mixed Method	To evaluate the implementation of hybrid learning in sports education, especially in Pencak Silat sport at Mpu Kuturan State College Singaraja.	This study found that students' perceptions were very positive and challenges in this hybrid learning were balancing between offline and online activities, participating in face-to-face learning activities, getting reliable internet connection and technological devices.	Journal of Higher Education Theory and Practice (Scopus)
(Anifah, Zuhrie, Muhammad, Haryanto, Holis, & Sudibyo, 2022)	Indonesia	Hardware and Software Design	To propose a new approach in identifying punches and kicks in Pencak Silat, considering that punches and kicks are the basis for determining scores in matches.	The main research result of this study is the analysis of sensor placement on the plough to get the best accuracy in assisting referees in determining the score of pencak silat matches.	ICEECIT 2022 - Proceedings: 2022 International Conference on Electrical Engineering, Computer and Information Technology (Scopus)
(Muktiani, Rahayu, & Hermawan, 2022)	Indonesia	Research and Development	To produce Augmented Reality Mobile App-based multimedia of Pencak silat learning for junior high school students.	Augmented Reality Mobile App-based pencak silat learning multimedia is effective for improving the achievement of high school students and can be used in pencak silat learning for high school students.	Cakrawala Pendidikan (Scopus)
(Nelson, Darni, & Haris, 2022)	Indonesia	Research and Development	To produce pencak silat learning media in terms of practicality, attractiveness and validity.	The results of the study according to the results of expert validation of the development of Augmented Reality-based martial arts learning media show very good results and are suitable for use as learning media.	Educational Administration: Theory and Practice (Scopus)
(Ng & Jumadi, 2022)	Malaysia	Research and Development	To develop an IoT-based instrumentation device and evaluate its effectiveness in measuring reaction time, kick impact force, and flexibility index in Silat athletes. The study aims to provide valuable data for coaches and trainers to improve training programs and enhance performance in Silat sports. Additionally, the research explores the potential of IoT technology in sports science and biomechanics research.	The study successfully developed an IoT-based instrumentation prototype for measuring the reaction time, kick impact force, and flexibility index of Silat athletes based on the Simple Reaction Time (SRT) task. These outcomes contribute to the understanding and improvement of performance in Silat sports.	International Journal of Electrical and Electronic Engineering and Telecommunications (Scopus)
(Lubis, Haqiyah, Kusumawati, Irawan, Hanief, & Riyadi, 2022)	Indonesia	Research and Development	To determine the efficacy of problem-based learning and the flipped classroom model combined with an Android application based on biomechanical analysis to improve the learning outcome of pencak silat and focused on teaching students the movement of a	The combination of problem-based learning and flipped classroom models with Android applications has been proven effective in improving Pencak Silat learning achievement.	Journal of Physical Education and Sport (Scopus)

Author and Year	Country	Methods	Purpose	Outcomes	Sources
			single artistic category of pencak silat.		
(Rohayati, Hodiyah, & Marwan, 2022)	Indonesia	Research and Development	To determine the development process of three-dimensional Virtual Reality (3-D VR) model design and its application for learning languages in junior high schools undertaking training in Pencak silat, the Indonesian traditional martial art.	The findings suggested that virtual reality display (audio visual) could be utilized for language learning. It was also evident that the development of 3-D VR technology for junior high school physical education subjects, especially in the implementation of learning activities with the scientific approach method, can meet the language learning needs of students' by influencing their cognitive and affective skills and keep students from understanding abstract and complex things.	Eurasian Journal of Applied Linguistics (Scopus)
(Sampurna, Istiono, & Suryadibrata, 2021)	Indonesia	Research and Development	To develop a rhythm game media with virtual reality technology in pencak silat.	The virtual reality game introduction to pencak silat with the fisher-yates shuffle method has been successfully designed and developed.	International Journal of Interactive Mobile Technologies (Scopus)
(Anifah, Zuhrie, & Muhammad, 2021)	Indonesia	Hardware and Software Design	To propose a new approach in identifying punches and kicks in Pencak Silat, considering that punches and kicks are the basis for determining scores in matches.	The experimental results showed that the system can recognize all movements properly, indicating its effectiveness in identifying punches and kicks This suggests that the proposed method can contribute to improving performance during training and matches. Overall, the study successfully developed a method for identifying punches and kicks in Pencak Silat using fuzzy logic, achieving high accuracy and excellent system performance. The system has the potential to enhance the learning and scoring processes in Pencak Silat matches.	ICRACOS 2021 - 2021 3rd International Conference on Research and Academic Community Services: Sustainable Innovation in Research and Community Services for Better Quality of Life towards Society (Scopus)
(Mokhsin, Zainol, Ibrahim, Som, Basit, & Azman, 2019)	Malaysia	Research and Development	To identify the requirements, design and develop Augmented Reality mobile learning application about Malay Historical Figures with the commercial name of ARMyPat (Augmented Reality based in Learning about Malay Patriots).	The study demonstrated the potential benefits of using augmented reality in learning activities and provided insights into the design and development process of an augmented reality mobile learning application.	Intelligent and Interactive Computing (Scopus & WoS)
(Ihsan, Yulkifli Yohandri, 2017)	Indonesia	Research and Development	To develop and test a speed measurement system for pencak silat kick using sensor technology.	This research successfully developed and validated a speed measurement system for pencak silat kick, providing a standardized instrument for accurately measuring kick speed in the sport.	1st Annual Applied Science and Engineering Conference (AASEC), in conjuction with The International Conference on Sport Science, Health, and Physical Education (ICSSHPE) 16–18 November 2016, Bandung, Indonesia (Scopus & WoS)
(Soh, Jafri, & Azraai, 2015)	Malaysia	n/a	To understand the movement patterns and dynamics of martial arts players and determine the relationship between kinetic energy, velocity, and work done by utilising 3D motion capture technology.	This research demonstrates the application of 3D motion capture technology in understanding and analysing human movement kinetics can quantify player movements in Silat martial arts.	AIP Conference Proceedings (Scopus & WoS)

Based on Table 1, the findings of this literature review categorise the role of technology in Pencak Silat into four main aspects:

Technical and Tactical Aspects of Pencak Silat

Depending on the characteristics and outcomes of each study, it could involve more in-depth analyses related to the technical and tactical aspects of Pencak Silat games. For example, RFID technology (Anifah et al., 2023), fuzzy logic (Anifah et al., 2022), and sensors (Gao et al., 2021) can contribute to improve strategy and execution of certain moves. Further studies on the role of technology in helping coaches and athletes identify weaknesses and reinforce strengths in competition could provide a more in-depth view. This analysis could detail how the implementation of certain technologies, such as sensors, could provide critical information to optimise tactics and improve the technical aspects of each match.

Point Scoring Feedback in Pencak Silat

In the context of the role of technology in the sport of Pencak Silat, we can extend the analysis to the point-scoring feedback system. RFID technology (Anifah et al., 2023) and fuzzy logic (Anifah et al., 2022) not only improve the accuracy of movement scoring but also how such feedback affects the overall match. These analyses may include the athlete's response to the system, changes in match strategy, and how improved scoring accuracy may affect the outcome of the competition. Furthermore, the application of this technology could change the dynamics of match strategy by providing opportunities for athletes and coaches to devise smarter tactics based on more accurate point data.

Current and Future Trends in Technology in Pencak Silat

In addition to analysing existing research results, we can discuss the current and future trends of technology in Pencak Silat. For example, the use of Augmented Reality (AR) (Muktiani et al., 2022), Virtual Reality (VR) (Sampurna et al., 2021), 3D motion capture (Soh et al., 2015), sensors (Anifah et al., 2021; Gao et al., 2021; Ihsan et al., 2017), and the Internet of Things (IoT) technologies can evolve and potentially change the dynamics of matches and training in the future (Ng & Jumadi, 2022). Understanding these trends can provide insight into the direction of the development of Pencak Silat as a sport that is increasingly integrated with technology. This increased integration of technology not only enhances the athlete's learning experience but also creates new opportunities for innovation in training strategies and athlete performance evaluation.

The Effectiveness of Various Technologies in Pencak Silat Learning

Several studies in the context of physical education have revealed the effectiveness of technology in learning Pencak Silat. Interactive multimedia presentations have been shown to improve mastery of hand-to-hand stances (Lanos et al., 2023), while a combination of problem-based and flipped classroom learning models with Android applications is effective in improving Pencak Silat learning achievement (Lubis et al., 2022). Students also respond positively to hybrid learning that is balanced between offline and online activities (Yudaparmita et al., 2023). The use of augmented reality technology provides insight into the design and development of learning applications (Mokhsin et al., 2019; Nelson et al., 2022). Through the development of 3-D VR technology, students can develop cognitive and affective skills while avoiding the understanding of abstract and complex concepts (Rohayati et al., 2022). Overall, the use of these various technologies has successfully improved student achievement by presenting more engaging, interactive, and effective learning materials, as well as deepening their understanding of this martial art.

The main objective of this paper is to conduct an in-depth systematic literature review on the role of technology in the development of Pencak Silat. The findings from this literature review illustrate the role of technology in Pencak Silat in two main aspects, namely physical education learning and sports science. In addition, the review indicated that the role of technology can be extended to involve the technical and tactical aspects of Pencak Silat competition. Various technologies, such as RFID, fuzzy logic, and sensors, were identified as potential contributors to improving the strategy and execution of certain moves. A deeper analysis of the role of technology in helping coaches and athletes identify weaknesses and reinforce strengths could provide more comprehensive insights.

In the context of point scoring feedback, RFID and fuzzy logic technologies were also found to not only improve the accuracy of movement scoring but also have an impact on the overall course of the match. Athlete response to the system, changes in match strategy, and the impact of improved scoring accuracy on competition outcomes are the focus of further analysis. The importance of analysing the current and future trends of technology in martial arts was also highlighted. The use of technologies such as augmented reality (AR), virtual reality (VR), 3D motion capture, sensors, and the Internet of Things (IoT) could change the dynamics of matches and training in the future. Understanding these trends provides insight into how Pencak Silat is increasingly integrated with technology, creating opportunities for innovation in training strategies and athlete performance evaluation. In Pencak Silat learning, various technologies, such as interactive multimedia, problem-based learning models, and the use of augmented reality, have been shown to improve students' achievement. The development of 3-D VR technology also provides students with opportunities to develop cognitive and affective skills. Overall, the integration of these technologies has increased student engagement, learning effectiveness, and a deeper understanding of this martial art.

CONCLUSION

From this research, it can be concluded that technology has played a significant role in the development of Pencak Silat. An in-depth analysis of the technical and tactical aspects of Pencak Silat matches showed that technologies such as RFID, fuzzy logic, and sensors can make a positive contribution to improving the strategy and execution of certain moves. Point scoring feedback was also the focus of the research, where RFID technology and fuzzy logic not only improved the accuracy of movement scoring but also had an impact on the overall course of the match. Athletes' response to the system, changes in match strategy, and the impact of improved scoring accuracy on competition results are aspects that need to be further analysed.

In addition, through the analysis of current and future trends, it can be concluded that the evolution of technologies such as augmented reality (AR), virtual reality (VR), 3D motion capture, sensors, and the Internet of Things (IoT) has the potential to change the dynamics of matches and training in the future. Pencak Silat is increasingly integrated with technology, creating new opportunities for innovation in training strategies and athlete performance evaluation. Studies on the effectiveness of technology in Pencak Silat learning show that the use of various technologies, such as interactive multimedia, problem-based learning models, and augmented reality, can successfully improve student achievement by presenting more interesting, interactive, and effective learning materials.

Some limitations inherent in this review should be noted. Firstly, although a thorough literature search was conducted, some published research may have been overlooked due to the possibility that the keywords used were different from the current keywords used. Secondly, the databases used in the article search were limited to only two databases, namely Scopus and WoS. Overall, this research shows that technology has become an indispensable partner in developing Pencak Silat, with valuable contributions to education and sports science. However, to optimise the benefits of this technology, further studies are needed on efficient and effective implementation, fulfilling accessibility aspects, and addressing challenges that arise. Future researchers can also add other databases, such as ScienceDirect, ERIC, IEEE Xplore, ACM Digital Library, EBSCO, SPORTDiscus, and others, to the article search.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

REFERENCES

Abdul, R., Adefg, L., Bcdefg, Y. Y., & Ef, S. Y. (2022). Injury in Martial Art Activities: Focusing on Pencak Silat Athletes. *Ido Movement for Culture*, *22*(2), 53–62. https://doi.org/10.14589/ido.22.2S.7

Anifah, L., Zuhrie, M. S., Haryanto, Muhammad, Holis, N., & Sudibyo, M. R. F. (2022). A New Approach Puch and Kick Identification in Martial Sport Pencak Silat Using Fuzzy Logic. *ICEECIT 2022 - Proceedings: 2022 International Conference on Electrical Engineering, Computer and Information Technology*, 34–38. https://doi.org/10.1109/ICEECIT55908.2022.10030299

Anifah, L., Zuhrie, M. S., & Muhammad. (2021). Sensor Positioning Effectiveness Analysis of Smart Pirates on Pencak Silat Sport. *ICRACOS 2021 - 2021 3rd International Conference on Research and Academic Community Services: Sustainable Innovation in Research and Community Services for Better Quality of Life towards Society 5*, 296–300. https://doi.org/10.1109/ICRACOS53680.2021.9701995

Anifah, L., Zuhrie, M. S., Muhammad, & Haryanto. (2023). Integrated Smart Real Time Scoring Pencak Silat Based on Internet of Things (IoT). *International Journal on Technical and Physical Problems of Engineering*, *15*(54), 155–163.

Ediyono, S., & Widodo, S. T. (2019). Memahami Makna Seni dalam Pencak Silat. *Panggung*, *29*(3), 299–313. https://doi.org/10.26742/panggung.v29i3.1014

Farid, S., Azril, H., Sha, M., & Fauzi, A. (2020). Heigh-Ho, Heigh-Ho, to the Rural Libraries We Go! - a Systematic Literature Review. *Library and Information Science Research*, *42*(1), 100997. https://doi.org/10.1016/j.lisr.2019.100997

Gao, T., Lou, Y., Sivaparthipan, C. ., & Alazab, M. (2021). Prediction of Athlete Movements using Wearable Sensors for Sports Person Health Monitoring Application. *Journal of Intelligent & Fuzzy Systems*, *15*(2), 1–12. https://doi.org/10.3233/JIFS-219160

Ihsan, N., Yulkifli, & Yohandri. (2017). Development of Speed Measurement System for Pencak Silat Kick Based on Sensor Technology. *Journal of Physics: Conference Series*, *180*, 1–9. https://doi.org/10.1088/1742-6596/755/1/011001

Kusumo, E., & Lemy, D. M. (2021). Pengembangan Budaya Pencak Silat sebagai Atraksi Pariwisata Budaya di Indonesia (Studi pada Perguruan Pencak Silat Merpati Putih). *Jurnal Pariwisata Pesona*, *6*(1), 75–80. https://doi.org/10.26905/jpp.v6i1.5872

Lanos, M. E. C., Ihsan, N., Okilanda, A., Handayani, W., Manullang, J. G., & Lestari, H. (2023). Effectiveness of Interactive Multimedia Supported Physical Education using Jurus Tunggal Tangan Kosong in the New Normal Era. *International Journal of Human Movement and Sports Sciences*, *11*(2), 261–267. https://doi.org/10.13189/saj.2023.110201

Lubis, J., Haqiyah, A., Kusumawati, M., Irawan, A. A., Hanief, Y. N., & Riyadi, D. N. (2022). Do Problem-Based Learning and Flipped Classroom Models Integrated with Android Applications based on Biomechanical Analysis Enhance the Learning Outcomes of Pencak Silat?. *Journal of Physical Education and Sport*, *22*(12), 3016–3022. https://doi.org/10.7752/jpes.2022.12381

Mardius, A., Barlian, E., & Ihsan, N. (2023). Development of a Media Display of the Truth F Single-Motion for Athletes, Coaches, and Referees-Judges Pencak Silat in Padang City. *Curricula : Journal of Teaching and Learning*, *8*(1), 21–29. https://doi.org/10.22216/curricula.v8i1.2070

Mokhsin, M., Zainol, A. S., Ibrahim, E. N. M., Som, M. H. M., Basit, K. A. A., & Azman, A. A. (2019). ARMyPat: Mobile Application in Learning Malay Historical Patriots using Augmented Reality. In V. Piuri, V. E. Balas, S. Borah, & S. S. S. Ahmad (Eds.). Lecture Notes in Networks and Systems. *International Conference on Intelligent and Interactive Computing (IIC)*, *67*(2), 425–445. https://doi.org/10.1007/978-981-13-6031-2_6

Muktiani, N. R., Soegiyanto, Siswantoyo, Rahayu, S., & Hermawan, H. A. (2022). Augmented Reality Mobile App-Based Multimedia Learning of Pencak Silat to Enhance the Junior High School Students' Learning Outcomes. *Cakrawala Pendidikan*, *41*(2), 553–568. https://doi.org/10.21831/cp.v41i2.49217

Nelson, S., Darni, R., & Haris, F. (2022). Development Augmented Reality (AR) Learning Media for Pencak Silat Course at Faculty of Sports and Science Universitas Negeri Padang. *Educational Administration: Theory and Practice*, *28*(1), 37–46. https://doi.org/10.17762/kuey.v28i01.322

Ng, C. K., & Jumadi, N. A. (2022). IoT-Based Instrumentation Development for Reaction Time, Kick Impact Force, and Flexibility Index Measurement. *International Journal of Electrical and Electronic Engineering and Telecommunications*, *11*(1), 82–87. https://doi.org/10.18178/ijeetc.11.1.82-87

Perdima, F. E., Suwarni, & Gazali, N. (2022). Educational Technology in Physical Education Learning: A Bibliometric Analysis using Scopus Database. *SPORT TK-Revista EuroAmericana de Ciencias Del Deporte*, *11*(2), 34–42. https://doi.org/10.6018/sportk.517091

Raibowo, S., Syafrial, Arwin, Prabowo, A., & Permadi, A. (2023). Development of Pencak Silat Learning Media in the Form of Pocket Books for Junior High Schools. *Kinestetik : Jurnal Ilmiah Pendidikan Jasmani*, *7*(1), 228–233. https://doi.org/10.33369/jk.v7i1.26029

Riyadi, D. N., Haqiyah, A., & Putranto, A. B. (2023). Android Application Design Based on Biomechanical Analysis for Pencak Silat Learning, it's Effective ?. *Halaman Olahraga Nusantara (Jurnal Ilmu Keolahragaan)*, *6*(2), 763–776. https://doi.org/10.31851/hon.v6i2.12292

Rohayati, N., Hodiyah, I., & Marwan, I. (2022). Development of Three-Dimensional Virtual Reality Technology for Learning Languages in Pencak Silat Curriculum. *Eurasian Journal of Applied Linguistics*, *8*(2), 283–290. https://doi.org/10.32601/ejal.911561

Sampurna, J., Istiono, W., & Suryadibrata, A. (2021). Virtual Reality Game for Introducing Pencak Silat. *International Journal of Interactive Mobile Technologies*, *15*(1), 199–207. https://doi.org/10.3991/IJIM.V15I01.17679

Saputro, D. P., Nasuka, Winarno, M. E., & Sulaiman. (2021). Pengembangan Software dalam Pencak Silat: Sebuah Studi pada Jurnal Terakreditasi Science and Technology Index (SINTA). *Prosiding Seminar Nasional Pascasarjana Universitas Negeri Semarang*, *6*(1),184–190.

Sarkis-Onofre, R., Catalá-López, F., Aromataris, E., & Lockwood, C. (2021). How to Properly use the PRISMA Statement. *Systematic Reviews*, *10*(1), 13–15. https://doi.org/10.1186/s13643-021-01671-z

Shaffril, H. A. M., Samah, A. A., Samsuddin, S. F., & Ali, Z. (2019). Mirror-Mirror on the Wall, what Climate Change Adaptation Strategies are Practiced by the Asian's Fishermen of All?. *Journal of Cleaner Production*, *232*, 104–117. https://doi.org/10.1016/j.jclepro.2019.05.262

Soh, A. A. S. A., Jafri, M. Z. M., & Azraai, N. Z. (2015). Study of Human Body: Kinematics and Kinetics of a Martial Arts (Silat) Performers using 3D-Motion Capture. *AIP Conference Proceedings*, *1657*, 1–5. https://doi.org/10.1063/1.4915170

Sumarno, A., Muhtarom, I., & Herlina, D. (2020). Development of Android-Based Silat Teaching Materialsin Karawang. *Palarch's Journal Of Archaeology Of Egypt/Egyptology*, *17*(9), 8877–8881.

Sweileh, W. M. (2020). Bibliometric Analysis of Peer-Reviewed Literature on Food Security in the Context of Climate change from 1980 to 2019. *Agriculture and Food Security*, *9*(1), 1–15. https://doi.org/10.1186/s40066-020-00266-6

Syaifullah, R., Nugroho, H., & Doewes, R. I. (2023). Perceived Stress Scale and Self Esteem in Pencak Silat Athletes before the 2022 Sea Games Competition. *Revista Iberoamericana de Psicología del Ejercicio Y El Deporte*, *18*(4), 424–426.

Yang, K., Lee, H., Kim, S., Lee, J., & Oh, D.-G. (2021). KCI vs. WoS: Comparative Analysis of Korean and International Journal Publications in Library and Information Science. *Journal of Information Science Theory and Practice*, *9*(3), 76–106. https://doi.org/10.1633/JISTaP.2021.9.3.6

Yudaparmita, G. N. A., Kanca, I. N., Sudiana, I. K., & Dharmadi, M. A. (2023). Hybrid Learning on Pencak Silat Sport in Higher Education: Students' Perception and Issues. *Journal of Higher Education Theory and Practice*, *23*(1), 9–22. https://doi.org/10.33423/jhetp.v23i1.5781