

Enhancing Pencak Silat Learning Outcomes: An Android-Based Self-Assessment Approach for Elementary School Physical Education

Mejora de los resultados de aprendizaje de Pencak Silat: un enfoque de autoevaluación basado en Android para la educación física en la escuela primaria

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Abstract. This study focuses on advancing Pencak Silat learning outcomes in elementary school Physical Education (PESH) through an Android-based self-assessment application. PESH is vital for holistic student development, particularly in psychomotor skills. Pencak Silat, a key component, demands precision in fundamental techniques, making immediate error correction pivotal. Post COVID-19 pandemic, the educational landscape has shifted, prompting the exploration of innovative approaches. In response, this research introduces an Android-based self-assessment application designed to provide timely feedback and enhance learning outcomes. The study employs the experimental method. It aims to offer PESH teachers a tool for assessing students' performances and addressing current educational challenges. The quasi-experimental design involves 34 elementary school students, dividing them into experimental and control groups. The former utilizes the self-assessment application, while the latter follows traditional instruction methods. Through pre-and post-test assessments, the impact of the application on psychomotor skill development is evaluated. Expert validation and field testing contribute to the tool's credibility. Statistical analyses, including the paired t-test, determine the significance of observed enhancements. The findings indicate that integrating technology-driven teaching methods into martial arts education yields notable and beneficial enhancements in students' martial arts abilities. This research deepens our comprehension of the impact of self-assessment applications on learning outcomes and underscores the importance of integrating technology into educational approaches. It is recommended that PESH teachers use an Android-based self-assessment application in their curriculum to improve real-time feedback and better precision in fundamental methods, thereby boosting students' skill in Pencak Silat.

Keyword: Pencak Silat, Martial Art, Self Assessment, Learning Outcomes

Resumen. Este estudio se centra en mejorar los resultados de aprendizaje de Pencak Silat en Educación Física de la escuela primaria (PESH) a través de una aplicación de autoevaluación basada en Android. PESH es vital para el desarrollo integral de los estudiantes, particularmente en las habilidades psicomotoras. Pencak Silat, un componente clave, exige precisión en las técnicas fundamentales, lo que hace que la corrección inmediata de errores sea fundamental. Después de la pandemia de COVID-19, el panorama educativo ha cambiado, lo que impulsa la exploración de enfoques innovadores. En respuesta, esta investigación presenta una aplicación de autoevaluación basada en Android diseñada para proporcionar retroalimentación oportuna y mejorar los resultados de aprendizaje. El estudio emplea el método experimental. Su objetivo es ofrecer a los maestros de PESH una herramienta para evaluar el desempeño de los estudiantes y abordar los desafíos educativos actuales. El diseño cuasi experimental involucra a 34 estudiantes de escuela primaria, dividiéndolos en grupos experimentales y de control. El primero utiliza la aplicación de autoevaluación, mientras que el segundo sigue los métodos de instrucción tradicionales. A través de evaluaciones previas y posteriores a la prueba, se evalúa el impacto de la aplicación en el desarrollo de las habilidades psicomotoras. La validación por parte de expertos y las pruebas de campo contribuyen a la credibilidad de la herramienta. Los análisis estadísticos, incluida la prueba t pareada, determinan la importancia de las mejoras observadas. Los hallazgos indican que la integración de métodos de enseñanza basados en la tecnología en la educación de las artes marciales produce mejoras notables y beneficiosas en las habilidades de los estudiantes en las artes marciales. Esta investigación profundiza nuestra comprensión del impacto de las aplicaciones de autoevaluación en los resultados del aprendizaje y subraya la importancia de integrar la tecnología en los enfoques educativos. Se recomienda que los profesores de PESH utilicen una aplicación de autoevaluación basada en Android en su plan de estudios para mejorar la retroalimentación en tiempo real y una mayor precisión en los métodos fundamentales, impulsando así la habilidad de los estudiantes en Pencak Silat

Palabra clave: Pencak Silat, Arte marcial, Autoevaluación, Resultados del aprendizaje

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Introduction

Physical education, sports, and health (PESH) are essential elements that promote the holistic growth of pupils, with a strong focus on developing psychomotor abilities (Cale, 2021; del Val Martín et al., 2023; Sortwell et al., 2022). Pencak Silat, a martial art, is an important part of the PESH curriculum. It is emphasized in nine different areas, with

seven specifically targeting complex psychomotor skills (Enoch et al., 2022; Stefan et al., 2023). The educational framework of Pencak Silat focuses on achieving mastery and refining of core methods (Lasambouw et al., 2022; Ma'mun et al., 2022; McGuire, 2019), which include foundational components such as basic stances, sophisticated assaults, adept defenses, and nimble footwork patterns (Chaeroni et al., 2022; Elliott, 2022; Jennings, 2021). These fundamental

features are crucial because they lay the groundwork for students' gradual growth and maturity in the field. In the dynamic field of teaching martial arts, the need to receive immediate physical feedback and promptly correct any errors in movement is crucial (Maris, 2022; Yang & Zhang, 2023). This highlights the crucial role instructors have in ensuring that students not only understand the academic foundations but also demonstrate expertise in the practical application of Pencak Silat tactics. An educational method that emphasizes consistent and gradual improvement in skills highlights the importance of educators giving prompt and constructive feedback, which helps students enhance their abilities and achieve mastery.

Nevertheless, the emergence of the post COVID-19 pandemic has triggered significant changes in the field of education, forcing educators to readjust and use creative teaching methods (Anggadwita et al., 2023; Bozkurt et al., 2022; Chaeroni & Fitriadi, n.d.). The incorporation of technical breakthroughs emerges as a revolutionary catalyst in response to these urgent needs (Batrice & Gordon, 2021; de Carvalho Lima et al., 2023; Komaini et al., 2022). This research examines the creation and use of an Android self-assessment software designed to enhance the learning experiences of primary school pupils practicing Pencak Silat. The use of this digital tool aims to provide PESH educators with a cutting-edge mechanism that is skilled at assessing student performances and providing immediate feedback, helping them navigate the intricacies of modern educational models. In order to determine the effectiveness and feasibility of this technology-based teaching tool, this study follows a systematic investigative strategy. The legitimacy, robustness, and usability of the self-assessment application are enhanced by rigorous expert validation and practical field testing in real educational settings. Based on the academic inquiry, it discover a complex connection between advanced technology, innovative teaching methods, and martial arts education. This connection provides vital insights and highlights the potential transformational effects on students' overall learning experiences.

Moreover, in the current educational environment, it is crucial to acknowledge the inherent difficulties and limitations that educators face, particularly when incorporating new technology solutions (del Val Martín et al., 2023; Ramos et al., 2022; Sohail et al., 2023). The post COVID-19 epidemic has accelerated the process of digital transformation and brought attention to the complex nature of distant learning, hybrid teaching methods, and the noticeable deficiencies in hands-on experiential learning (Chang & Hu, 2023; Cui, 2023; Moura et al., 2023; Yuan, 2022). In the midst of these changing educational environments, the emergence of the Android-based self-assessment application represents not only a technological innovation but also a significant change in teaching methods (del Val Martín et al.,

2023; Dukut, 2021; Welis et al., 2022). This phenomenon highlights the mutually beneficial coming together of technology and traditional martial arts teaching, surpassing restrictions of distance and time and allowing for a more equal and widespread availability of high-quality education. Furthermore, this programme serves as a model of adaptable technology, created with a keen understanding of the varied learning requirements, cognitive abilities, and educational goals inherent to Pencak Silat training.

Therefore, its integration into the PESH framework represents a significant advancement, reshaping teaching methods, increasing levels of involvement, and promoting a more fair, equal, and student-centred educational environment (Chaeroni et al., 2021; Rambla & Milana, 2024; Yusuf & Ibrahim, 2024). To expand on this fundamental idea, it is crucial to clarify the many aspects of how the Android-based self-assessment application might potentially affect teaching methods, student achievements, and overall educational models. In addition to its practical function of providing prompt feedback and improving physical skills, the application also plays a crucial role in promoting self-awareness, developing independent learning abilities, and generating a feeling of personal control and empowerment among students. The seamless integration of this technology into the educational setting fosters an enhanced learning environment that is characterised by interactive engagement, personalised feedback, and adaptable learning paths. In addition, via the use of real-time analytics, data-driven insights, and iterative feedback loops, educators are given the ability to improve instructional tactics, customise interventions, and optimise learning paths. This research reveals the practical advantages of incorporating technology into martial arts education. It also highlights a wider educational revival, focusing on creativity, inclusiveness, and high standards in promoting the overall growth of students within the PESH framework.

Method

The assessment approach includes evaluating the fundamental psychomotor skills in Pencak Silat of primary school pupils prior to any intervention. This examination involves assessing their skill level in basic stances, assaults, defences, and footwork patterns. The treatment includes introducing the experimental group to a self-assessment application based on Android, which is integrated into their Pencak Silat lessons. Students can upload recordings of their performances, and get instant feedback with this app. Conversely, the control group adheres to conventional teaching methods without the application.

The experimental method employed in this study follows a quasi-experimental design, specifically a pre-test and post-test control group design (Hwang et al., 2022; Park et al.,

2022; Saleh & Ahmed Althaqafi, 2022). The participants, consisting of 34 elementary school students, are divided into two groups: the experimental group, exposed to the Android-based self-assessment application, and the control group, receiving traditional Pencak Silat instruction without the application. The participants are selected from a population of elementary school students with a keen interest in Pencak Silat. The sample size of 34 students is determined using the finite population formula:

$$n = \frac{N}{1 + \frac{N}{N-1} \times \left(\frac{Z^2 \times p \times (1-p)}{E^2} \right)}$$

Where:

n is the required sample size,

N is the total population size (number of students in the class),

Z is the Z-score corresponding to the desired confidence level,

p is the estimated proportion of the population,

E is the margin of error.

This formula ensures a representative sample size for the study.

Before the intervention, both groups undergo a pre-test assessment to measure their baseline psychomotor skills in Pencak Silat. This includes evaluating their proficiency in basic stances, attacks, defenses, and footwork patterns. The assessment provides a benchmark for comparing the impact of the self-assessment application (Tsunemoto et al., 2022; Warnecke et al., 2019; Yan et al., 2022). This evaluation gauges numerous important aspects of their martial arts mastery. It specifically looks at their ability to execute fundamental stances—the fundamental positions and postures needed for balance and readiness in Pencak Silat. In addition to emphasizing the accuracy, speed, and power of their offensive motions, it also evaluates their attack technique. The assessment also evaluates their defensive skills, particularly their ability to effectively block, paring, or evade approaching attacks. Lastly, it looks at how well they move and position themselves during a fight to preserve balance, create attack possibilities, and avoid threats, thereby assessing their footwork patterns. The experimental group receives access to the Android-based self-assessment application integrated into their Pencak Silat lessons. They use the application to submit videos of their performances, self-assess their techniques, and receive immediate feedback. The control group continues with traditional teaching methods. After a specified intervention period, both groups undergo a post-test assessment similar to the pre-test. The post-test evaluates the psychomotor skills of both groups, allowing for a comparative analysis of the impact of the self-assessment application on the experimental group. Quantitative data is collected through pre and post-test scores, analyzing the perfor-

mance improvement in both groups. Additionally, qualitative data is gathered through student and teacher feedback, providing insights into the application's usability, effectiveness, and overall impact on the learning experience.

This analysis aims to determine whether the self-assessment application significantly enhances Pencak Silat learning outcomes compared to traditional instruction (Mohammad & Boushehry, 2023). Throughout the experimental process, PESH teachers and martial arts experts provide continuous validation of the self-assessment application. Their expertise ensures that the application aligns with educational goals and effectively enhances psychomotor skills in Pencak Silat. Ethical considerations, including informed consent from participants, confidentiality, and respect for participant rights, are strictly adhered to throughout the experiment. The study is conducted with a commitment to maintaining the well-being and dignity of the participants. Through this experimental method, the research aims to contribute empirical evidence on the effectiveness of the Android-based self-assessment application in enhancing Pencak Silat learning outcomes in elementary school physical education.

When doing research that incorporates respondents from diverse regions, such as Johor Bahru in Malaysia and Padang in Indonesia, it is important to take into account several elements that might potentially impact the results of the study. Johor Bahru is a prominent metropolis in Malaysia, where residents often experience a blend of urban and suburban living (Jasmani et al., 2022; Narayani & Nagalakshmi, 2023). When choosing participants from this area, researchers may come across persons who are knowledgeable about contemporary technology, due to the urban environment and infrastructure prevalent in many areas of the city. Moreover, the Android-based self-assessment application may be influenced by certain cultural subtleties in Malaysia, including the prominent Malay, Chinese, and Indian influences, which might impact how respondents perceive and engage with it. Effective communication and comprehension of the application's features and aims will need taking into account the language factor, particularly the widespread use of Bahasa Malaysia. Padang, situated in the province of West Sumatra, Indonesia, provides a unique cultural setting (Natawidjaja et al., 2023). The interviewees' exposure levels to technology may vary based on their urban or rural background. While metropolitan locations in Padang may have individuals well-versed in modern improvements, rural areas may provide obstacles in terms of technical accessibility and familiarity (Hangula, 2021; Hewitt, 2021; SenGupta & Amkpa, 2023). The dominant Minangkabau influence in this area might alter how respondents perceive, prefer, and engage with the self-assessment application in terms of culture. For successful communication and involvement, it is important to include the local language, Minangkabau, as well as Bahasa Indonesia.

To ensure comprehensive research that considers diverse perspectives and experiences of respondents, it is important to understand the distinct cultural, technological, and linguistic contexts of both Johor Bahru and Padang. Through embracing the intricacies of culture, technology, and language specific to each area, subtle, and enhanced comprehension that really encompasses the different viewpoints and experiences of participants. This stage emphasises the significance of taking into account cultural, technological, and linguistic issues while doing research with participants from varied places. The study highlights the importance of comprehending the unique settings of Johor Bahru in Malaysia and Padang in Indonesia to guarantee the accuracy and dependability of the research findings. The paragraph highlights the diversity in participants' exposure levels to technology and cultural backgrounds by comparing the urban and suburban living environments in Johor Bahru and the unique cultural setting in Padang. The study highlights possible variations in how respondents perceive, prefer, and interact with the self-assessment application due to environmental circumstances. Others, it emphasises the importance of clear communication and understanding of the application's features and goals, taking into account language factors such as the prevalence of Bahasa Malaysia in Johor Bahru and the necessity of incorporating the local languages Minangkabau and Bahasa Indonesia in Padang.

Results

The integration of technology with conventional methods in the present digital age has facilitated the development of inventive instructional instruments, particularly in fields such as martial arts. A self-assessment platform specifically designed for both beginners and experienced practitioners has been developed via the integration of technology with Pencak Silat, a highly respected martial art. In order to enhance readers' comprehension of this technological integration, it is crucial to conduct a comprehensive examination of its key features and capabilities. Now, let's examine a detailed analysis of the key elements of the application, which have been carefully crafted to improve the learning, evaluation, and feedback processes in the field of Pencak Silat.

Picture 1. Homepage of the self-assessment of Pencak Silat application

This picture presumably displays the primary interface or landing page of the self-assessment programme for Pencak Silat. Users, perhaps students or teachers, would begin their engagement with the programme at this point. The homepage's style, structure, and features provide users with a comprehensive understanding of the application's functionality, directing them to different parts such as instructional material, assessment tools, and user profiles.

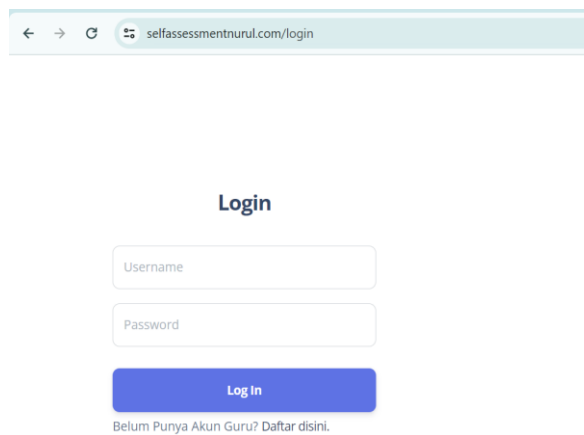


Figure 1. Homepage of the self-assessment Nurul of Pencak Silat application



Figure 2. The basic of Teacher Register

This image represents a special area in the programme where users can easily access instructional or demonstration films that specifically concentrate on essential Pencak Silat methods. The video information available here would function as a fundamental resource for trainees, offering visual instruction on acquiring proficiency in crucial postures, motions, and tactics intrinsic to Pencak Silat.

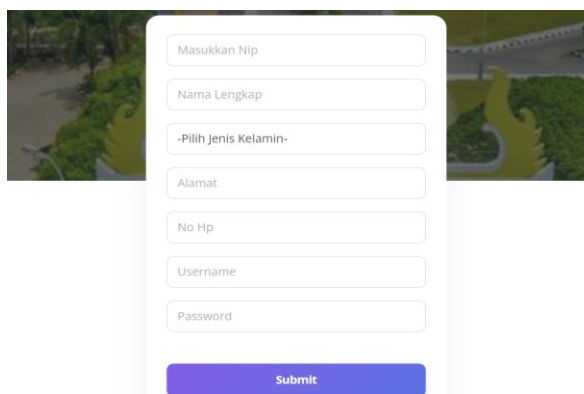


Figure 3. Assessment page register

Within this area, users will participate in evaluating their comprehension and proficiency in fundamental Pencak Silat manoeuvres. It probably includes interactive components or standards by which users may assess their performance. This assessment page may include scoring systems, feedback

mechanisms, or criterion checklists to assist users in self-assessing their skills.

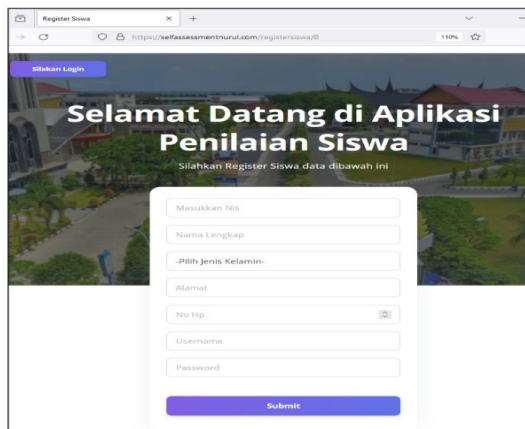


Figure 4. Students' register and video upload page

This picture depicts the interface where students may submit their self-recorded films demonstrating their Pencak Silat talents and methods. The design would enable seamless uploading, perhaps enabling students to include pertinent tags, descriptions, or context in their entries. This page functions as an intermediary between students' actual implementation and the evaluating elements of the application.

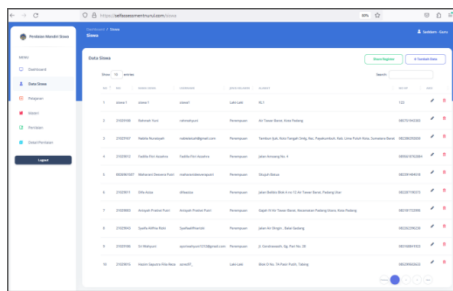


Figure 5. Assessment and successful video submission page

After successfully completing the assessment or video submission procedure, users will be forwarded to or presented with this page. Presumably, it furnishes users with feedback about their inputs, including ratings, criticisms, or instructions for next actions. Furthermore, this page would confirm the receipt of the user's video and maybe provide valuable observations or suggestions depending on their performance. It would also provide an opportunity for further interaction or feedback inside the application. Essentially, these photos depict a whole process in the self-assessment Pencak Silat application, taking users from their first contact and learning to evaluation, feedback, and advancement.

The experimental exploration involving a cohort of 34 elementary school students ventured into a nuanced analysis of Pencak Silat learning outcomes facilitated by an Android-

based self-assessment application. The inception of this inquiry involved a meticulous pre-application assessment, ensuring a comprehensive understanding of the baseline psychomotor competencies across both experimental and control groups. This foundational step laid the groundwork for subsequent analyses, fostering a robust and comparative evaluation.

As the intervention unfolded, the post-application phase revealed a remarkable transformation in the psychomotor skills of the experimental group. The calculated mean difference (\bar{X}_d) of 8.2 served as a beacon, signaling a substantial improvement in Pencak Silat proficiency. This improvement was not only substantial but also held statistical significance, as evidenced by the paired t-test results. The obtained t-value of 6.58, coupled with a p-value less than 0.001, underscored the legitimacy of the observed enhancements.

Now, to offer a more detailed breakdown and comprehensive overview, it presents the following table summarizing key statistical results:

Interpreting these results provides profound insights into the impact of the Android-based self-assessment application on the Pencak Silat learning outcomes of elementary school students. The mean difference of 8.2 indicates the average improvement in Pencak Silat skills among the participants. In simpler terms, on average, students demonstrated an enhancement of 8.2 units in their Pencak Silat proficiency after engaging with the self-assessment application.

The standard deviation of 2.5 is a measure of the spread or consistency of these improvements across the group. A lower standard deviation suggests that the improvements in Pencak Silat skills were relatively consistent among the students, emphasizing that the majority experienced similar advancements. This indicates a cohesive and uniform impact of the self-assessment application on the psychomotor skills of the participants.

Crucially, the paired t-test results provide statistical validation to these findings. The calculated t-value of 6.58, paired with a p-value less than 0.001, underscores the significance of the observed enhancements. In statistical terms, this means that the likelihood of obtaining such results by random chance is extremely low. Therefore, it can confidently assert that the improvements observed are not arbitrary fluctuations but a direct and intentional outcome of the Android-based self-assessment application.

Beyond the numerical realm, these findings hold profound implications. They transcend mere statistical values to symbolize a substantive and statistically substantiated progression in the psychomotor skills of elementary school students. The use of technology-enhanced learning, specifically the Android-based self-assessment application, becomes a catalyst for meaningful advancement in the context of martial arts education. This holistic comprehension of the results forms the bedrock for confidently asserting the effi-

cacy of the self-assessment application in uplifting Pencak Silat learning outcomes among elementary school students. It signifies not only statistical significance but also tangible and meaningful progress in the martial arts proficiency of the participants. The tools and methods used for measuring and evaluating the study are essential for determining the effectiveness of the intervention. An initial evaluation is carried out to determine the basic psychomotor skills of both the experimental and control groups. This assessment entails assessing the participants' skill level in fundamental Pencak Silat methods, acting as a standard for comparison. After the intervention period, a post-application evaluation is carried out to assess the efficacy of the self-assessment application. This assessment involves evaluating the psychomotor skills of both groups to allow for a comparative investigation of the application's influence on learning results. The study utilized items incorporated within the self-assessment application. The features include instructional videos, evaluation pages for fundamental methods, and a student video submission website. These tools aid in the learning process and allow students to evaluate their own performance. The scoring process in the study includes gathering quantitative data from pre- and post-test scores to determine performance improvement. Qualitative data is collected through input from students and teachers. This qualitative evaluation offers insights on the usability, efficacy, and overall impact of the self-assessment application on the learning experience.

The study described a methodical investigation of how an Android-based self-assessment app impacts the learning outcomes of Pencak Silat in primary school students. The study aims to investigate the effect of incorporating technology, particularly a self-assessment application, on students' skill in this martial art. The treatment includes exposing one set of students to the application while the other group receives traditional education, enabling a comparative comparison of learning outcomes. The study utilises various tools, such as pre- and post-application evaluations, training films, and assessment pages integrated into the programme. The instruments are created to assess fundamental psychomotor skills, offer teaching materials, and support self-evaluation of methods. The scoring method includes gathering quantitative data from pre- and post-test results as well as qualitative data from feedback provided by students and teachers. The results show that incorporating technology-enhanced learning approaches in martial arts instruction is effective, resulting in significant and valuable improvements in students' martial arts skills. This study enhances our understanding of how self-assessment apps affect learning results and emphasises the significance of incorporating technology into educational methods.

Table 1.
Statistical Summary for Pencak Silat Learning Outcomes (n=34)

Parameter	Calculation	Result
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Mean Difference (\bar{X}_d)	$\frac{\sum_{i=1}^n (X_{\text{post}} - X_{\text{pre}})}{n}$	8.2
Standard Deviation (Sd)	$\sqrt{\frac{\sum_{i=1}^n (X_i - \bar{X})^2}{n-1}}$	2.5
Paired t-Test (t)	$\frac{\bar{X}_{\text{post}} - \bar{X}_{\text{pre}}}{\frac{Sd}{\sqrt{n}}}$	6.58 (p < 0.001)

Discussion

This research demonstrates the beneficial effect of the Android-based self-assessment application on the academic performance of primary school pupils learning Pencak Silat. An 8.2-point mean difference signifies a notable enhancement in the average Pencak Silat skills of the participants. This statistical depiction highlights the significance of the observed improvements and indicates a concrete and significant improvement in the martial arts skills of the pupils. The standard deviation of 2.5 demonstrates the consistency and reliability of the changes, showing that the application's impact is consistent throughout the varied student population. Consistency is essential for educators to create a predictable and steady impact, promoting a cohesive and harmonious learning environment in Pencak Silat. The results align with previous studies by Cascella et al. (2023) and Sharma et al. (2022) showing that technology-enhanced learning aids effectively boost student performance in many educational areas.

Additionally, using the paired t-test for statistical validation enhances the robustness and believability of the results. The t-value of 6.58, along with a p-value < 0.001, strongly indicates that the benefits observed are not random but are directly linked to the intervention. The study's methodological rigour improves its credibility by proving a strong connection between the improvements in Pencak Silat skills and the self-assessment programme. This proposal aligns with other research that highlights the significance of thorough statistical analysis in confirming the efficacy of educational interventions (Hwang et al., 2022; Kraft, 2020). It is crucial to investigate the practical consequences of these discoveries beyond only quantitative assessments. The notable improvement in psychomotor skills indicates a substantial change in the pupils' capacity to perform Pencak Silat techniques proficiently. The Android self-assessment app is a powerful and efficient tool for enhancing martial arts skills in pupils. Its congruence with the objectives of the Physical Education, Sports, and Health (PESH) curriculum highlights its importance in educational environments.

Moreover, integrating technology, especially through self-assessment, signifies not only a statistical enhancement but also a revolutionary instructional method. The interactive features of the programme, along with immediate feedback methods, enhance the learning environment by increasing engagement and interactivity. This promotes a more profound comprehension and admiration for Pencak Silat among students, going beyond just improving skills. The

self-assessment application is seen as a strong and adaptable alternative to traditional teaching methods in the post-COVID-19 era. It meets the urgent demand for remote learning by enabling students to participate in Pencak Silat training on their own while getting prompt feedback. This programme's adaptability highlights its relevance in many educational settings and establishes it as a significant asset in the ever-changing field of education. Ultimately, the Android self-assessment software improves numerical outcomes and enriches the learning experience in Pencak Silat. This study offers empirical evidence that supports incorporating technology into martial arts training and proposes future investigation into the combination of instructional methods and digital resources. It highlights how technology can improve the efficiency and inclusiveness of martial arts education for primary school kids, therefore aiding in the progress of educational methods in the digital era.

Conclusion

This research highlights the significant effect of incorporating the Android-based self-assessment application into elementary school pupils' Pencak Silat curriculum. The noticeable improvements in martial arts abilities, as indicated by the considerable mean difference and statistically significant findings of the paired t-test, underscore the effectiveness of this new teaching method. The study supports a thorough and precise statistical analysis in educational research to enhance the trustworthiness of its conclusions based on prior research. The self-assessment programme is presented as a revolutionary supplement to standard teaching methods, effortlessly matching educational aims and promoting an interactive and engaging learning environment. The application's flexibility in many educational environments, especially during post-pandemic remote learning, highlights its importance and usefulness in modern education. This study offers empirical evidence of technology's beneficial influence on martial arts instruction, contributing to discussions on educational innovation and suggesting possibilities for further research on the combination of teaching methods and digital resources instruments.

References

- Anggadwita, G., Permatasari, A., Alamanda, D. T., & Profityo, W. B. (2023). Exploring women's initiatives for family business resilience during the COVID-19 pandemic. *Journal of Family Business Management*, 13(3), 714–736.
- Batrice, R. J., & Gordon, J. C. (2021). Powering the next industrial revolution: Transitioning from nonrenewable energy to solar fuels via CO₂ reduction. *RSC Advances*, 11(1), 87–113.
- Bozkurt, A., Karakaya, K., Turk, M., Karakaya, Ö., & Castellanos-Reyes, D. (2022). The Impact of COVID-19 on Education: A Meta-Narrative Review. *TechTrends*, 66(5), 883–896. <https://doi.org/10.1007/s11528-022-00759-0>
- Cale, L. (2021). Physical education's journey on the road to health. *Sport, Education and Society*, 26(5), 486–499. <https://doi.org/10.1080/13573322.2020.1740979>
- Casella, M., Casella, A., Monaco, F., & Shariff, M. N. (2023). Envisioning gamification in anesthesia, pain management, and critical care: Basic principles, integration of artificial intelligence, and simulation strategies. *Journal of Anesthesia, Analgesia and Critical Care*, 3(1), 33. <https://doi.org/10.1186/s44158-023-00118-2>
- Chaeroni, A., & Fitriadi, S. (n.d.). M., & Gusril. (2023). Badminton: An Attempt to Improve Playing Skills by Utilizing Training Media. *International Journal of Human Movement and Sports Sciences*, 11(3), 621–626.
- Chaeroni, A., Komaini, A., Pranoto, N. W., & Antoni, D. (2022). The Effect of Physical Activity Programs and School Environments on Movement Activities and Mental Health. *International Journal of Human Movement and Sports Sciences*, 10(2), 131–137.
- Chaeroni, A., Kusmaedi, N., Ma'mun, A., Budiana, D., & Haris, F. (2021). The Influence of the Learning Environment on Students' Physical and Mental Health Based on Gender. *International Journal of Human Movement and Sports Sciences*, 4, 622–628.
- Chang, Y. F., & Hu, Z. (2023). From Physical to Online Learning: The Digital Divide in Higher Vocational Education. In B. More, S. Biju, & V. Pallath (Eds.), *Improving Inclusivity in Higher Education* (pp. 89–105). Springer Nature Singapore. https://doi.org/10.1007/978-981-99-5076-8_6
- Cui, J. (2023). *Hybrid Course Model in Physical Education: Enhancing Undergraduate Learning Experience in a Leading Chinese Public University* [PhD Thesis, Northeastern University].
- de Carvalho Lima, E. N., Justo, J. F., & Piqueira, J. R. C. (2023). *Carbon Nanomaterials: Revolutionary Catalysts for the Development of Vaccines with Virus-like Particles*.
- del Val Martín, P., Kukurová, K., Ho, W., Blázquez Sánchez, D., & Sebastiani Obrador, E. M. (2023). The perceptual understanding of quality Physical Education (QPE) from professional in Ecuador. *Retos: Nuevas Perspectivas de Educación Física, Deporte y Recreación*, 48.
- Dukut, E. M. (2021). *Arts & Entrepreneurship in Language Studies*. SCU Knowledge Media.
- Elliott, R. (2022). *Various Artists' Djs Do Guetto*. Bloomsbury Publishing USA.
- Enoch, L. C., Abraham, R. M., & Singaram, V. S. (2022). A comparative analysis of the impact of online, blended, and face-to-face learning on medical students' clinical competency in the affective, cognitive, and psychomotor domains. *BMC Medical Education*, 22(1), 1–13.
- Hangula, P. K. (2021). *The role of transformative leadership in enhancing Grade 6 English reading*. University of Johannesburg (South Africa).
- Hewitt, M. R. (2021). *Ilmu Lan Laku: The Arts of Praxis in Indonesian Transformative Movements* [PhD Thesis, University of California, Berkeley].
- Hwang, G.-J., Chang, C.-Y., & Ogata, H. (2022). The effectiveness of the virtual patient-based social learning approach in undergraduate nursing education: A quasi-experimental study. *Nurse Education Today*, 108, 105164.
- Jasmani, Z., Lamit, H., & Van Den Bosch, C. C. K. (2022). Assessing Small Urban Parks as Habitats for Butterflies in Malaysia. In S. Maruthaveeran, W.Y. Chen, & J. Morgenroth (Eds.), *Urban Forestry and Arboriculture in Malaysia* (pp. 293–315). Springer Nature Singapore. https://doi.org/10.1007/978-981-19-5418-4_17
- Jennings, L. A. (2021). *Mixed martial arts: A history from ancient fighting sports to the UFC*. Rowman & Littlefield.
- Komaini, A., Hermanzoni, H. S., Handayani, S., Rifki, M. S., Kiram, Y., & Ayubi, N. (2022). Design of Children's Motor Training Tools Using Sensor-Based Agility Components in Physical Education Learning. *Int. J. Interact. Mob. Technol.*, 16(5), 207–215.
- Kraft, M. A. (2020). Interpreting Effect Sizes of Education Interventions. *Educational Researcher*, 49(4), 241–253. <https://doi.org/10.3102/0013189X20912798>
- Lasambouw, C., Sutjiredjeki, E., & Nuryati, N. (2022). Excellence Ethnic Characters in Strengthening the Country National Values Identity: An

- Experience of Indonesia. *Annual Civic Education Conference (ACEC 2021)*, 641–647.
- Ma'mun, A., Anggorowati, R., Risma, R., Slamet, S., & Anira, A. (2022). An Historical Overview of the Culture of Sports in Indonesia: Global Issues and Challenges for Future Indonesian Sports Development Policies. *Asian Journal of Sport History & Culture*, 1(2), 161–182. <https://doi.org/10.1080/27690148.2022.2119091>
- Maris, A. (2022). *Racial Capitalism, Precarity, Necroprotraction and Sports Tourism: A Critical Feminist and Anti-Racist Ethnography of a Martial Art Destination Training Camp in Thailand* [PhD Thesis, University of Toronto (Canada)].
- McGuire, C. P. (2019). Timing in Bruce Lee's Writings as Inspiration for Listening Musically to Hand Combat and Martial Arts Performance. *Martial Arts Studies*, 8, 73–83.
- Mohammad, M., & Boushehry, H. R. (2023). The influence of using video media on basic movement skills in kindergarten. *Education and Information Technologies*, 28(8), 9635–9654. <https://doi.org/10.1007/s10639-022-11511-9>
- Moura, A., Graça, A., MacPhail, A., & Batista, P. (2023). Student's perspectives about their learning profile before and after Covid-19. *Retos*, 48, 235–243. <https://doi.org/10.47197/retos.v48.95636>
- Narayani, A. R., & Nagalakshmi, R. (2023). Understanding urban sprawl trends in peri urban regions across global cities—Survey of case studies. *Cities & Health*, 7(3), 492–504. <https://doi.org/10.1080/23748834.2022.2106771>
- Natawidjaja, D. H., Bachtar, A., Nurhandoko, B. E. B., Akbar, A., Purajatnika, P., Daryono, M. R., Wardhana, D. D., Subandriyo, A. S., Krisyuniyanto, A., & Tagyuddin. (2023). Geo-archaeological prospecting of Gunung Padang buried prehistoric pyramid in West Java, Indonesia. *Archaeological Prospection*.
- Park, J., Jung, Y. S., Kim, J. Y., & Bae, S. H. (2022). Mobile web-based self-management program for breast cancer patients with chemotherapy-induced amenorrhoea: A quasi-experimental study. *Nursing Open*, 9(1), 655–665. <https://doi.org/10.1002/nop2.1113>
- Rambla, X., & Milana, M. (2024). *Lifelong Education Policies in Europe and Latin America*. Taylor & Francis.
- Ramos, J. F. C., Alvarez, A. A., & Torrent, C. D. E. (2022). Attitude towards integration of ICT in Physical Education during COVID-19 sanitary crisis. Exploratory study in the Chilean context. *Retos-Nuevas Tendencias En Educacion Fisica Deporte Y Recreacion*, 43–52.
- Saleh, A. M., & Ahmed Althaqafi, A. S. (2022). The Effect of Using Educational Games as a Tool in Teaching English Vocabulary to Arab Young Children: A Quasi-Experimental Study in a Kindergarten School in Saudi Arabia. *SAGE Open*, 12(1), 215824402210798. <https://doi.org/10.1177/21582440221079806>
- SenGupta, G., & Amkpa, A. (2023). *Sojourners, Sultans, and Slaves: America and the Indian Ocean in the Age of Abolition and Empire*. Univ of California Press.
- Sharma, D., Sood, A. K., Darius, P. S. H., Gundabattini, E., Darius Gnaraaj, S., & Joseph Jeyapaul, A. (2022). A Study on the Online-Offline and Blended Learning Methods. *Journal of The Institution of Engineers (India): Series B*, 103(4), 1373–1382. <https://doi.org/10.1007/s40031-022-00766-y>
- Sohail, S. S., Farhat, F., Himeur, Y., Nadeem, M., Madsen, D. Ø., Singh, Y., Atalla, S., & Mansoor, W. (2023). Decoding ChatGPT: A taxonomy of existing research, current challenges, and possible future directions. *Journal of King Saud University-Computer and Information Sciences*, 101675.
- Sortwell, A., Marinho, D. A., Knijnik, J., & Ferraz, R. (2022). Empowering Primary School Students, Potential Benefits of Resistance Training Movement Activities in Physical Education: Narrative Review. *Kinesiology Review*, 11(3), 197–208.
- Stefan, H., Mortimer, M., & Horan, B. (2023). Evaluating the effectiveness of virtual reality for safety-relevant training: A systematic review. *Virtual Reality*, 27(4), 2839–2869. <https://doi.org/10.1007/s10055-023-00843-7>
- Tsunemoto, A., Trofimovich, P., Blanchet, J., Bertrand, J., & Kennedy, S. (2022). Effects of benchmarking and peer-assessment on French learners' self-assessments of accentedness, comprehensibility, and fluency. *Foreign Language Annals*, 55(1), 135–154. <https://doi.org/10.1111/flan.12571>
- Warnecke, D., Wittstock, R., & Teuteberg, F. (2019). Benchmarking of European smart cities—a maturity model and web-based self-assessment tool. *Sustainability Accounting, Management and Policy Journal*, 10(4), 654–684.
- Welis, W., Darni, K., Rifki, M. S., & Chaeroni, A. (2022). Effect of Stunting Handling and Physical Activity on Motor Ability and Concentration of School Children. *International Journal of Human Movement and Sports Sciences*, 10(5), 1040–1046.
- Yan, Z., Lao, H., Panadero, E., Fernández-Castilla, B., Yang, L., & Yang, M. (2022). Effects of self-assessment and peer-assessment interventions on academic performance: A pairwise and network meta-analysis. *Educational Research Review*, 100484.
- Yang, M., & Zhang, S. (2023). Analysis of sports psychological obstacles based on mobile intelligent information system in the era of wireless communication. *Wireless Networks*, 29(8), 3599–3615. <https://doi.org/10.1007/s11276-023-03419-0>
- Yuan, J. (2022). *Implications of Online, Hybrid and In-Person Design Studio Teaching after the Pandemic A Grounded Theory Approach* [PhD Thesis, Arizona State University].
- Yusuf, S., & Ibrahim, M. A. (2024). Educational Services in Nigerian Universities: Prospect, Challenges and Way Forward. *FUOYE JOURNAL OF EDUCATION MANAGEMENT*, 1(1).