Effectiveness of Taekwondo Fight Evaluation (TAFEVAL) application among taekwondo coaches
Eficacia de la aplicación de la Evaluación del Combate de Taekwondo (TAFEVAL) entre los entrenadores de taekwondo

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Abstract

Introduction: This study develops and assesses an Android-based evaluation application for Kyurugi Taekwondo athlete performance. The demand for precise performance assessment necessitates digital tools to enhance evaluation accuracy. This application provides a structured, real-time system for coaches to monitor technical, physical, tactical, and psychological aspects. Method: This study employed a Design-Based Research (DBR) approach involving 55 purposively selected Taekwondo coaches from West Java. The research comprised five stages: 1) a literature review to identify gaps in kyurugi performance evaluation and relevant technologies; 2) prototype development using B4X software based on identified needs; 3) expert validation by a subject matter expert, an informatics expert, and a measurement expert; 4) small-scale field testing with 15 coaches to assess feasibility and usability; and 5) final product revision and broader effectiveness testing with 40 coaches. Data collection included validation checklists, usability surveys, interviews, and in-app analytics.
Result: Findings show the application is highly effective for real-time evaluations, offering accessible performance data anytime. Usability assessments indicate it is user-friendly and practical for coaching. The structured framework enhances comprehensive athlete analysis. However, recommendations were made to refine the assessment of psychological aspects for a more holistic evaluation. Conclusion: This application is a valuable tool for Taekwondo coaches, enabling structured and well-documented performance assessment. Real-time feedback and systematic evaluation enhance training quality and athlete development. Future improvements should focus on refining psychological evaluations to better assess athlete readiness and mental resilience.

Keywords

Coaches; evaluation; fight; kyurugi; taekwondo.

Resumen

Introducción: Este estudio desarrolla y evalúa una aplicación de evaluación basada en Android para el rendimiento de atletas de Taekwondo Kyurugi. La demanda de una evaluación precisa del rendimiento requiere herramientas digitales para mejorar la precisión de la evaluación. Esta aplicación proporciona un sistema estructurado y en tiempo real para que los entrenadores controlen los aspectos técnicos, físicos, tácticos y psicológicos.
Método: Este estudio empleó un enfoque de Investigación Basada en el Diseño (IBR) en el que participaron 55 entrenadores de taekwondo de Java Occidental seleccionados intencionadamente. La investigación constó de cinco fases: 1) una revisión de la literatura para identificar las lagunas en la evaluación del rendimiento del kyurugi y las tecnologías pertinentes; 2) el desarrollo de un prototipo utilizando el software B4X basado en las necesidades identificadas; 3) la validación de expertos por un experto en la materia, un experto en informática y un experto en medición; 4) pruebas de campo a pequeña escala con 15 entrenadores para evaluar la viabilidad y la usabilidad; y 5) la revisión final del producto y pruebas de eficacia más amplias con 40 entrenadores. La recopilación de datos incluyó listas de validación, encuestas de usabilidad, entrevistas y análisis de la aplicación. Resultados: Los resultados muestran que la aplicación es muy eficaz para las evaluaciones en tiempo real, ofreciendo datos de rendimiento accesibles en cualquier momento. Las evaluaciones de usabilidad indican que es fácil de utilizar y práctica para el entrenamiento. El marco estructurado mejora el análisis exhaustivo de los deportistas. Sin embargo, se hicieron recomendaciones para refinar la evaluación de los aspectos psicológicos para una evaluación más holística. Conclusiones: Esta aplicación es una herramienta valiosa para los entrenadores de Taekwondo, ya que permite una evaluación del rendimiento estructurada y bien documentada. La retroalimentación en tiempo real y la evaluación sistemática mejoran la calidad del entrenamiento y el desarrollo del atleta. Las mejoras futuras deberían centrarse en perfeccionar las evaluaciones psicológicas para evaluar mejor la preparación y la resiliencia mental de los atletas.

Palabras clave

Entrenadores; evaluación; lucha; kyurugi; taekwondo.

Introduction

Taekwondo, a martial art with roots in Korea, has evolved into a globally recognized sport, prominently featured in events such as the Olympics and the World Taekwondo Championships. This growth is evidenced by an increasing number of practitioners and competitions at both local and international levels. The dynamic and full-contact nature of Taekwondo, particularly in the kyurugi (sparring) category, presents continuous challenges for athletes, necessitating ongoing refinement of technical skills, speed, and strategic execution. As highlighted by Boutios et al. (2022), performance evaluation is crucial in this context, as it enables coaches to assess athletes' strengths and weaknesses effectively, thereby facilitating targeted training improvements. The reliance on traditional evaluation methods, which often depend on subjective judgments and manual documentation, poses significant limitations. These methods can lead to inconsistencies and hinder comprehensive longitudinal analyses, restricting access to historical performance data that could inform training strategies (Sousa et al., 2023).

The limitations inherent in traditional evaluation methods underscore the need for structured performance assessments in Taekwondo. Agopyan et al. (2022) emphasize that without advanced evaluative tools, the potential for optimizing athlete performance is severely restricted. Furthermore, the evolving nature of competition rules and strategies in Taekwondo, as noted by Ming-chuan et al. (2022), necessitates the development of accurate and adaptable tools capable of delivering real-time insights. Such tools would enable athletes to refine their techniques and strategies in accordance with the latest competition standards, ultimately enhancing their performance outcomes.

In recent years, the integration of technology into sports has led to the emergence designed to streamline performance evaluation processes (Malik & Nur, 2020). These applications, particularly those developed for Android platforms, facilitate real-time data collection, analysis, and storage. Tayech et al. (2020) demonstrated the efficacy of an Android-based application for measuring aerobic capacity, showcasing the potential of mobile platforms in performance evaluation. However, research specifically targeting kyurugi performance evaluation remains limited. Worsey et al. (2019) argue that traditional assessment methods are insufficient for capturing the high demands of kyurugi, which requires precision, speed, and tactical awareness. A digital application tailored to kyurugi could provide systematic monitoring of athletes' technical skills, physical condition, tactical decision-making, and mental resilience, thereby offering a more objective and comprehensive assessment framework.

Despite the increasing adoption of mobile applications in various sports, a significant research gap persists regarding performance evaluation tools specifically designed for Taekwondo kyurugi. Castro-Garrido et al. (2020) highlight that the unique demands of kyurugi necessitate an evaluation model capable of adapting to dynamic changes in rules and scoring systems. The portability and adaptability of Android-based platforms make them particularly suitable for application in diverse settings, including training environments and international competitions. By developing an Android-based performance evaluation application for kyurugi, this study aims to address the identified gap, presenting a structured model that incorporates technical, physical, tactical, and mental performance metrics. This tool would provide coaches with actionable, data-driven insights, supporting real-time feedback and objective analysis, thus facilitating more precise and tailored training adjustments for athletes.

The overarching goal of this research is to develop, test, and evaluate the effectiveness of a mobile application designed to enhance the quality of performance assessments among Taekwondo coaches. By addressing the limitations of traditional evaluation methods and leveraging technological advancements, this study aims to contribute significantly to the methodology of athlete evaluation in martial arts contexts. As the sport continues to evolve, the integration of innovative performance evaluation tools will be essential for fostering athlete development and optimizing competitive performance in Taekwondo.

Method

The Design-Based Research (DBR) approach employed in this study is particularly effective for developing and testing educational technologies in real-world settings, as it emphasizes iterative cycles of design, testing, analysis, and refinement. This methodology is crucial for ensuring that the developed

application is not only theoretically sound but also practically relevant and effective in the context of Taekwondo performance evaluation. The iterative nature of DBR allows for continuous improvement based on user feedback, which is essential for creating tools that meet the specific needs of coaches and athletes alike (Hammes et al., 2022; Ghezelseflou, 2023).

Participants

The study involved 55 Taekwondo coaches in West Java, aged between 25 and 47 years. All participants held national-level coaching licenses and had substantial experience in competitive Taekwondo coaching, ensuring the relevance of their feedback to real-world training environments. A purposive sampling design was employed to select participants who met specific inclusion criteria—namely, certification status, active coaching experience, and involvement in athlete development. This non-probability sampling technique was chosen to ensure the selection of information-rich cases, aligning with the goals of Design-Based Research to gather in-depth insights from expert users.

Procedure, data collection and analysis

1. Needs Analysis

The initial phase of the study consisted of a literature review aimed at examining current practices and limitations in Taekwondo performance evaluation, with a specific focus on *kyurugi*. It also explored the integration of technological applications in sports performance assessment. This theoretical foundation served to identify existing gaps and inform the preliminary design of the evaluation framework.

2. Prototype Development

Based on the initial findings, a prototype of the Android-based Taekwondo evaluation application is developed using B4X software, a versatile, cross-platform development tool suitable for Android application design. The prototype includes several features designed to assess athletes' performance across technical, physical, tactical, and mental parameters, using customizable metrics identified by the coaches during the FGD. The development process emphasizes creating an intuitive interface to simplify use in dynamic training and competitive environments. Coaches can enter data related to each performance category, and the application processes this input to generate real-time feedback and store performance records for longitudinal tracking. The use of B4X allows for rapid iterations, enabling the research team to make modifications based on user feedback quickly.

3. Expert Validation

After the prototype was developed, it underwent a structured expert validation process to assess its design quality, functionality, and content relevance. The validation involved three experts selected through purposive sampling, each representing a different area of specialization to ensure a comprehensive evaluation. The panel consisted of a Subject Matter Expert with extensive experience in Taekwondo kyurugi coaching and athlete performance evaluation, an Informatics Expert specializing in mobile application development and user interface/user experience (UI/UX) design, and a Measurement Test Expert with a background in educational and psychological assessment to ensure the accuracy and reliability of performance indicators. Each expert reviewed the prototype using a structured validation guideline covering content accuracy, system functionality, usability, data processing, and alignment with real-world coaching practices. Their feedback contributed significantly to the refinement of the application, including improvements in interface clarity, enhancement of assessment indicators, and optimization of data management features. This expert validation ensured that the application met high standards in both technical design and practical relevance, making it suitable for use in Taekwondo performance evaluation.

4. Small-Scale Field Testing

Following expert validation, the application was tested in a small-scale field trial involving a subset of 15 participating coaches. This stage aimed to assess the application's usability, practicality, and feasibility within real-world Taekwondo coaching contexts. Coaches utilized the application during training sessions to evaluate athletes' performances, with particular attention given to its ease of use, operational speed, and the clarity of the performance feedback generated. To systematically measure user feasibility, participants were asked to complete a Likert-scale questionnaire, rating various aspects of the application on a scale from 1 (strongly disagree) to 5 (strongly agree). The items evaluated included

ease of navigation, relevance of performance indicators, clarity of data presentation, and overall usefulness for coaching. The results of the Likert-scale responses provided quantitative evidence of feasibility, indicating a generally high level of user acceptance and satisfaction. In addition to the questionnaire, qualitative feedback was also collected to identify technical issues, design limitations, and potential improvements. Insights from this phase informed iterative revisions, ensuring that the final version of the application was both functionally robust and contextually relevant to the needs of Taekwondo coaches.

5. Product Revision and Effectiveness Testing

After making adjustments based on the field test, the final version of the application was developed and implemented in a broader trial involving all 40 participating coaches. These coaches were selected using purposive sampling, focusing on individuals who met specific inclusion criteria: holding Taekwondo coaching licenses, having active involvement in athlete training programs, and possessing prior experience with performance evaluation in kyurugi. The effectiveness of the application is measured by comparing it to traditional evaluation methods, focusing on accuracy, consistency, and coaches' ability to provide targeted feedback. Data is collected through performance evaluation questionnaires, in-app usage data, and feedback forms completed by the coaches. These data collection tools help measure the application's impact on coaches' assessment practices, including their ability to set measurable goals, monitor progress, and provide data-driven guidance.

Instrument

The effectiveness of the application was tested in a large-scale trial involving 40 participants. This evaluation aimed to gather comprehensive feedback on the usability, practicality, and overall effectiveness of the Android-based application in real-world Taekwondo coaching environments. The instrument used in this study included a set of 18 assessment items focused on various aspects of application functionality, usability, reliability, and user satisfaction. Each item was designed to capture specific dimensions related to the ease of use, efficiency, data accuracy, and cost-effectiveness of the application, as shown in Table 1.

Table 1. Android Application Effectiveness Testing Instrument

No	Indicator
1	This application is easy to use without requiring special training.
2	The instructions for using the application are clear and easy to understand.
3	The settings and navigation within the application are user-friendly.
4	The application can provide evaluation results quickly.
5	Using this application does not take excessive time in the field.
6	This application is easy to use in various competition locations.
7	The size and device requirements to run this application support coaches' mobility.
8	This application is cost-effective in its use.
9	The cost incurred for this application is proportional to the benefits provided.
10	The application works well without technical issues during use.
11	The application is resistant to disruptions or errors during field use.
12	The data generated by this application is accurate and consistent.
13	This application minimizes errors in measuring athlete performance.
14	This application is accessible and usable by all coaches who need it.
15	The application is available on various platforms commonly used by coaches.
16	This application is safe to use without posing risks to coaches or athletes.
17	This application does not require additional equipment that may pose risks.
18	Overall, I am satisfied with the practicality of this application in supporting the evaluation of athletes' competitive performance.

Results

The Android-based Taekwondo Fight Evaluation (TAFEVAL) application has been successfully developed, as shown in Figure 1. Overall, the application includes features such as a user guide, statistical recording, and data storage capabilities.

Figure 1. Taekwondo Fight Evaluation (TAFEVAL) Application

The next stage of the study involved evaluating the validity of the Taekwondo Fight Evaluation (TAFEVAL) application by consulting three experts. This evaluation was conducted using an expert validation questionnaire, with a detailed summary of the findings presented in Table 2. The results revealed that all three experts provided feasibility ratings above 80%. This indicates that the application meets the necessary standards of validity and functionality, demonstrating its readiness for further testing. Consequently, the Android-based TAFEVAL application is considered suitable for implementation in field trials, allowing researchers to gather user feedback and assess its practical effectiveness in real-world settings.

Table 2. Expert judgment results

Validator	Percentage of Assessment	Suggestion
Subject Matter Expert	82%	The app is very helpful and makes it easier for coaches and teams to evaluate matches. Suggestions include adding a landscape mode and increasing storage capacity.
Informatics Expert	96%	The coloring should be made softer and a back button should be added to the application.
Measurement Test Expert	100%	This application is complete and can be used to measure and evaluate Taekwondo match results. In the future, it can also be used to evaluate athletes' mental aspects.

After being validated and deemed feasible by all experts, the next step involved conducting user trials with 55 Taekwondo coaches serving as participants. These trials were carried out in two phases: a small-scale trial involving 15 coaches and a large-scale trial involving 40 coaches. The phased approach to testing allowed for a more systematic evaluation of the application. The small-scale trial provided an initial assessment of usability, identifying potential issues and enabling preliminary feedback collection. Insights from this phase informed refinements before proceeding to the large-scale trial. The large-scale trial then offered a broader perspective, testing the application's functionality, usability, and effectiveness across a more diverse group of users. The results of these trials are summarized in Table 3.

Table 3. Small-Scale and Large-Scale User Test Results

Types of Trials	User	Total Score	Mean	SD	Conclusion
The small-scale trial	15	82,8	4,60	0,37	Excellent
The large-scale trial	40	84,3	4,68	0,25	Excellent

The small-scale field trial of the Android-based performance evaluation application for Taekwondo Kyurugi was conducted with 15 coaches to assess its functionality and practicality in real or simulated match conditions. Feedback from the coaches during this phase was utilized to refine the application for improved effectiveness. The practicality test, evaluated by five coaches, yielded highly positive results. The application was rated as very user-friendly, with the highest scores in ease of use, cost-effectiveness, and device compatibility for coach mobility, all receiving perfect scores of 5. However, aspects such as resilience to technical disruptions (4.2) and data accuracy (4.4) received slightly lower ratings, but overall, the application was considered highly practical for field use.

A large-scale usability test involved 40 Taekwondo coaches, who provided an average total score of 84.3, with an individual user score of 4.68, categorizing the system as "Excellent." This high rating reflects

strong user support for the application in evaluating athlete performance during competitions, with a standard deviation of 0.25, indicating consistency in user feedback. The application's ease of use, effectiveness in providing structured feedback, and its efficiency compared to manual evaluation methods were notably highlighted. User responses regarding the effectiveness of the application, as presented in Table 4, indicate that coaches perceived the app as a valuable tool for systematically documenting athlete performance. Specifically, they noted its utility in capturing detailed information related to both physical and tactical dimensions of performance.

Table 4. User response regarding application effectiveness

Indicator	User Response
Field Time Efficiency (Indicator 5)	This application does not take excessive time when used in the field. This is very important in the context of sports, where time efficiency greatly determines the effectiveness of coaches in providing timely evaluations for athletes.
Mobility (Indicator 7)	The size and device requirements that support the coach's mobility make this application suitable for use in various field conditions. High mobility allows the application to be used flexibly, both indoors and outdoors
Cost Efficiency (Indicators 8 and 9)	Cost efficiency and benefits commensurate with application costs are important aspects in the selection of applications for athlete evaluation purposes. Cost-effective yet highly beneficial, this application increases its appeal among trainers who generally have limited budgets for technology.
Safety for Coaches and Athletes (Indicators 16 and 17)	Good application security includes protection for users from risks associated with the use of technology in active physical environments. Additionally, applications that do not require risky additional equipment demonstrate attention to user safety. This is important in the context of sports because safety factors directly impact the acceptance of new technology by coaches and athletes.

Discussion

The initial phase of the research involves comprehensive data collection, which is critical for understanding the current practices and limitations in Taekwondo performance evaluation, especially in kyurugi. A literature review serves as a theoretical foundation, identifying gaps in existing technologies and practices. This aligns with findings from Biçer et al. (2022), who emphasize the importance of understanding coaches' attitudes towards technology in athlete education, highlighting that coaches must be equipped with the necessary knowledge and skills to utilize technological advancements effectively. Additionally, focus group discussions (FGDs) with participating coaches provide qualitative insights into their challenges and preferences, ensuring that the application is designed with user needs in mind. This participatory approach is supported by Kirkland and Cowley, who note that effective communication and understanding of user experiences are vital for integrating technology into coaching practices (Kirkland & Cowley, 2023).

The development of the Android-based Taekwondo evaluation application is guided by the insights gathered during the needs analysis phase. Utilizing B4X software for prototype development allows for rapid iterations and modifications based on user feedback, which is essential for creating an intuitive interface that facilitates real-time data entry and feedback generation. This approach resonates with the findings of Wells et al. (2022) who discuss how coaches utilize various technologies in their practice, emphasizing the need for tools that enhance usability and provide clear performance insights. The focus on customizable metrics, as identified by coaches during FGDs, further ensures that the application aligns with the specific demands of Taekwondo performance evaluation (Ghezelseflou, 2023).

Expert validation of the prototype is a crucial step in the DBR process, as it ensures that the application accurately represents kyurugi performance metrics and adheres to usability standards. The involvement of Taekwondo experts and informatics specialists in this phase is essential for refining features and enhancing data accuracy. This aligns with the research of Rittenberg et al. (2022) who highlight the significance of expert knowledge in improving the effectiveness of technology use in coaching. By incorporating expert feedback, the application can better serve the needs of coaches and athletes, ultimately leading to more effective performance evaluations.

Following expert validation, small-scale field testing is conducted to assess the application's usability in real coaching settings. This phase allows coaches to evaluate athletes using the application during practice sessions, focusing on ease of use and the clarity of performance insights. The iterative DBR approach facilitates targeted revisions based on feedback from this field test, ensuring that the application evolves

to meet the practical needs of coaches. This iterative process is supported by the work of Düking et al. (2018) who discuss the potential usefulness of technology in enhancing athlete performance through systematic evaluation. The emphasis on usability and practicality in real-world settings is crucial for the successful adoption of the application by coaches.

After making adjustments based on the field test, the final version of the application undergoes extensive trials with all participating coaches. The effectiveness of the application is evaluated by comparing it to traditional evaluation methods, focusing on accuracy and consistency in performance assessments. This aligns with the findings of Adesida et al. (2019), who emphasize the importance of translating technological outputs into practical applications for coaches and athletes. Data collected through performance evaluation questionnaires and in-app usage data provide valuable insights into the application's impact on coaches' assessment practices, further demonstrating the effectiveness of the DBR approach in developing educational technologies.

The iterative cycles of development and evaluation inherent in the DBR approach ensure that the application evolves based on practical feedback, ultimately meeting the specific requirements of Taekwondo kyurugi evaluation. By focusing on the needs of real users—Taekwondo coaches—this study contributes to the growing body of research on digital tools for sport performance assessment. The integration of technology into coaching practices not only enhances athlete evaluation but also fosters a more data-driven approach to coaching, as highlighted by Harris et al. (2018), who discuss the implications of cognitive training devices in sports. This innovative solution represents a significant advancement in the field of sports coaching, providing coaches with the tools necessary to enhance athlete performance through objective and accurate evaluations.

Studies indicate that applications designed for sports need to minimize operational time to avoid disrupting the focus of coaches and athletes (Giblin et al., 2016; Ortega & Olmedo, 2017). Byun et al. (2018) further highlight that applications supporting high mobility are particularly effective in dynamic sports environments, as coaches are not required to carry large or complex equipment. In addition, cost-effectiveness is identified as a crucial factor in the selection of technology for training and evaluation, particularly given the often limited budgets in the sports sector (Sheng et al., 2023; Zhang et al., 2023). Moreover, user safety is an increasingly significant consideration in the development of field-based applications, especially those used in outdoor and physically demanding conditions (Mali & Dey, 2020; Zhang et al., 2023).

Conclusions

This research successfully developed an Android-based performance evaluation application for Kyurugi athletes that is effective and easy to use. This application helps coaches provide more detailed and documented evaluations, thus improving athlete training quality. Future research is recommended to expand the testing of this application at the national level and develop additional features for evaluation in other sports. For coaches and athletes, this application becomes a highly useful tool to enhance performance in competitions.

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