



Improving the Efficiency of Cognitive Assessment in Physical Education through a Web-Based Application

Samsuddin Siregar¹

¹ Physical Education Health and Recreation, Faculty of Sport Science, Universitas Negeri Medan, North Sumatra, Indonesia
samsuddinsiregar@unimed.ac.id

Abstract. Assessment of learning outcomes constitutes a critical component of instructional practice, enabling educators to evaluate students' attainment of predefined learning objectives in a valid and systematic manner. This study investigates the effectiveness of a web-based application in improving the efficiency of cognitive assessment processes in Physical Education (PE). An experimental design was employed involving three PE teachers at SMPN 1 Galang, Serdang Bedagai Regency, during May 2025. Data were collected using structured questionnaires and observation sheets and analyzed through descriptive percentage techniques. The findings indicate a substantial improvement in assessment efficiency following the implementation of the digital system. The baseline evaluation revealed that manual assessment procedures achieved an efficiency level of 75%. After integrating the web-based application, efficiency increased to 90%, reflecting a 15% gain in performance. This improvement suggests that digital assessment tools can streamline data processing, reduce administrative workload, and enhance the consistency and accuracy of evaluation practices. From a pedagogical perspective, the results are consistent with contemporary research emphasizing the role of digital technologies in optimizing assessment systems and supporting data-driven decision-making in education [1], [2]. In the context of sport and physical education, where timely and objective evaluation is essential, web-based platforms provide scalable and standardized solutions for measuring cognitive outcomes. In conclusion, the adoption of web-based assessment applications represents an effective strategy for enhancing the efficiency and reliability of cognitive evaluation in PE settings. Future studies are recommended to explore broader implementation across diverse educational contexts and to examine its impact on student performance and feedback quality.

Keywords: Learning outcomes assessment, physical education, web-based application, digital assessment, efficiency.

1 Introduction

Teachers play a crucial role in carrying out teaching and learning activities [1]. This role includes several aspects, including preparing materials, implementing learning, and assessing student learning [2]. As part of learning assessment, a teacher needs an

© The Author(s) 2026

I. I. I. Pane and Y. Putri (eds.), *Proceedings of the 2nd International Conference of Sport Science, Sport Coaching Science, and Physical Education, Health and Recreation 2025 (ICOSSCOPER 2025)*, Advances in Social Science, Education and Humanities Research 1022,

https://doi.org/10.2991/978-2-38476-591-1_33

effective evaluation tool to facilitate the assessment process. A good evaluation tool can be used as a basis for determining the adequacy of the requirements and rules of the evaluation instrument [3]. The tools used to assess learning are generally called evaluation instruments. In evaluation activities, an instrument is needed that functions as a guideline in its implementation.

Instruments are tools used to assess students' skills in mastering the material presented by the teacher [4]. The evaluation instruments created function to assess students' skills related to the subject matter that has been studied and can be an expected evaluation aspect [5]. Assessment instruments are generally used to measure students' abilities through tests. Tests are assessment instruments used to measure how well students understand the material that has been taught by the teacher [6].

Based on observations conducted in February at SMP Negeri 1 Galang, the cognitive assessment process for Physical Education (PJOK) utilizes written test sheets, which are then manually corrected by teachers. This assessment requires a significant amount of time and equipment, making it difficult for teachers to analyze student assessment results. This method carries significant risks, such as damage or loss of test sheets and inaccurate results. Furthermore, the use of test sheets often encourages students to cheat, such as copying from their peers. If this problem is not addressed immediately, the quality of education in these schools will be jeopardized, and students who are dishonest in their assessments will continue to harm themselves in the future. Therefore, the development of applications as a solution for more efficient and accurate assessments is very urgent. A web application is a program designed to help users perform certain tasks or activities quickly and accurately. Web applications can provide easy access to materials, questions, and assessments for students and teachers. Web applications can help distribute materials, work on questions, and process results automatically without the need for question sheets, long time, and help teachers analyze student assessment results. Using web applications, assessment data can be stored securely and easily accessed by students and teachers. Using web applications makes it easier for teachers to manage and monitor assessment results in real-time.

2 Literature

Assessment is a systematic process that encompasses planning, instrument development, data collection, and the utilization of results to enhance the quality of learning. In accordance with national educational policy, assessment is not merely a measurement activity but also a mechanism for continuous improvement in instructional practice [1]. Within contemporary educational frameworks, several types of assessment are recognized, each serving distinct pedagogical purposes.

Formative assessment is conducted during the learning process to provide immediate feedback that supports student progress and instructional adjustment. In contrast, summative assessment is administered at the end of an instructional period to evaluate the overall achievement of learning outcomes. Authentic assessment emphasizes the evaluation of students' abilities in real-world contexts, often through performance-based

tasks such as projects and presentations. In addition, cognitive, affective, and psychomotor assessments represent three fundamental domains of learning evaluation. Cognitive assessment focuses on students' understanding of concepts and intellectual abilities; affective assessment examines attitudes, values, and dispositions; while psychomotor assessment evaluates physical skills and performance, which are particularly relevant in Physical Education contexts [2], [3].

Cognitive assessment, as a central component of educational evaluation, measures higher order thinking skills, including reasoning, problem-solving, memory, and analytical abilities. In Physical Education, cognitive evaluation plays an important role in assessing students' comprehension of theoretical concepts such as rules of the game, physiological principles, and health-related knowledge. Effective cognitive assessment instruments typically include written tests, oral examinations, and structured assignments designed to capture students' conceptual understanding and critical thinking capacity [4].

Despite its importance, traditional cognitive assessment in Physical Education is often implemented using paper-based methods, which may limit efficiency and accuracy. Manual scoring processes are time-consuming and prone to human error, reducing the effectiveness of assessment as a tool for instructional improvement. Recent studies highlight the growing need for digital transformation in educational assessment systems to address these limitations [5].

In this context, the use of application-based technologies has emerged as a viable solution. An application can be defined as a software system designed to perform specific functions for users by processing data into meaningful outputs [6]. Web-based applications, in particular, provide flexible and accessible platforms that enable automated assessment, real-time feedback, and efficient data management. These systems support the integration of instructional content, assessment tools, and performance analytics within a single environment, thereby enhancing both teaching efficiency and learning effectiveness [7].

From an educational technology perspective, digital applications facilitate student-centered learning by allowing access to materials and assessments anytime and anywhere. This flexibility is particularly relevant in Physical Education, where the combination of theoretical and practical components requires efficient and adaptable assessment mechanisms. Empirical evidence indicates that the use of digital assessment platforms can significantly improve efficiency, accuracy, and transparency in evaluation processes, while also reducing administrative workload for teachers [8].

Therefore, the integration of web-based applications into cognitive assessment practices represents an important innovation in Physical Education. It not only addresses the limitations of conventional assessment methods but also aligns with current trends in technology-enhanced learning, emphasizing efficiency, scalability, and data-driven decision-making in education.

3 Method

This study employed a Research and Development (R&D) approach to design, implement, and evaluate a web-based application for improving the efficiency of cognitive assessment in Physical Education. The R&D method was selected due to its suitability for developing educational products and systematically testing their effectiveness in real learning environments [1].

The research was conducted at SMP Negeri 1 Galang, involving students from two Grade VIII classes as the primary participants. These participants were selected to represent the target users of the assessment system within a secondary-level Physical Education context. The study focused on evaluating the effectiveness of the web-based application in facilitating cognitive assessment processes.

Data were collected using a structured questionnaire instrument, designed to capture users' perceptions of efficiency, usability, and practicality of the developed system. The instrument employed a Likert scale to quantify responses across multiple indicators, ensuring consistency and reliability in measurement. The use of Likert-scale instruments is widely recognized in educational research for assessing attitudes and perceptions related to instructional innovations [2].

The data analysis procedure consisted of two main stages. First, qualitative response categories were transformed into quantitative scores based on the assigned Likert scale values. Second, the overall assessment score was calculated by comparing the total obtained score with the maximum possible (ideal) score, followed by conversion into percentage form. This approach enables a clear interpretation of effectiveness levels and facilitates comparison across different implementation stages.

From a methodological perspective, the use of quantitative descriptive analysis allows for systematic evaluation of the efficiency improvements generated by the web-based application. This aligns with contemporary research practices in educational technology, where percentage-based and descriptive statistical analyses are commonly used to assess the impact of digital interventions on learning processes [3], [4].

Overall, the selected methodology provides a structured framework for evaluating the feasibility and effectiveness of web-based assessment tools in Physical Education, ensuring that the findings are both empirically grounded and pedagogically relevant.

4 Results and Discussion

4.1 Results

The product developed in this study is a web-based cognitive assessment instrument designed to evaluate students' understanding of Physical Education, Sports, and Health (PJOK) content. The application integrates multiple functional modules, including a main dashboard, user management (teachers and students), question bank and item management, test administration interface, and automated scoring and reporting system. These features collectively support a structured and efficient assessment workflow.

The interface of the developed application (Fig. 1) demonstrates a user-oriented design that facilitates ease of navigation for both teachers and students. Key functionalities include question uploading, test initiation, real-time response submission, and automatic generation of assessment results. Such integration allows for seamless management of assessment activities within a single digital environment.

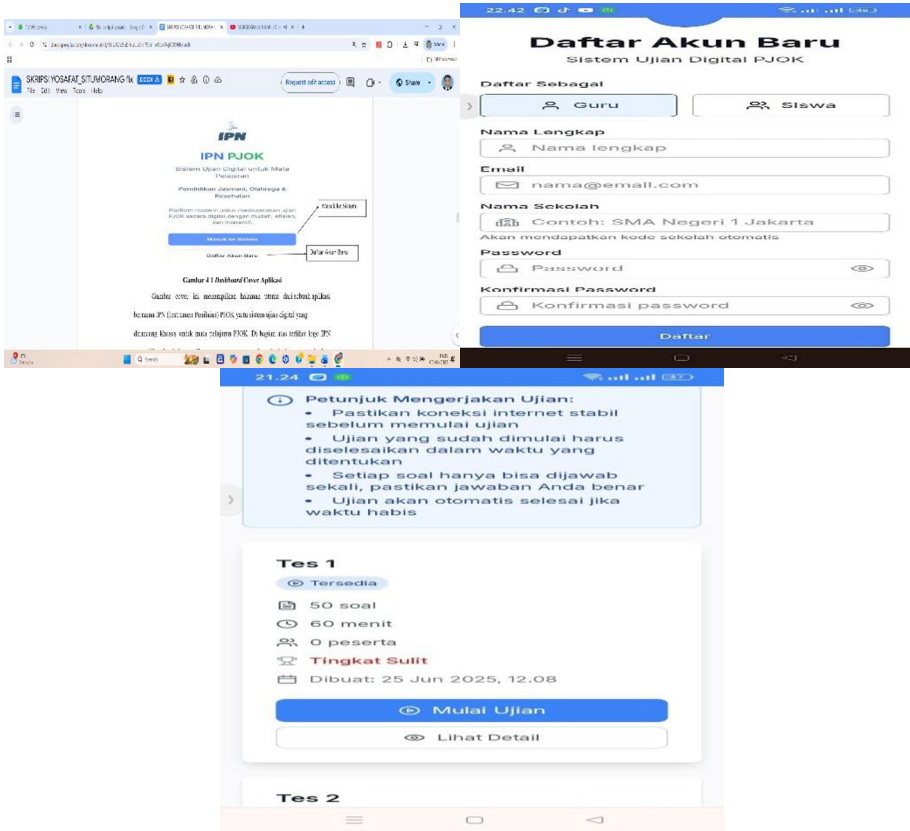


Fig. 1. Partial View of the PJOK Cognitive Assessment Application

The results of the large-group trial indicate a high level of user acceptance, with an overall student response rate of 91%, categorized as very positive. The evaluation covered several indicators, including system usability, clarity of test items, interface design, and perceived contribution to learning motivation. The majority of participants reported that the application was easy to operate, visually accessible, and effective in supporting the assessment process.

These findings suggest that the developed application meets the criteria of usability, functionality, and practicality, thereby confirming its feasibility as a digital assessment tool in Physical Education contexts.

4.2 Discussion

The results demonstrate that the implementation of a web-based cognitive assessment system significantly enhances the efficiency and quality of evaluation in Physical Education. The high level of student acceptance (91%) indicates that the application aligns well with learners' digital literacy and preferences, particularly in the context of 21st-century education, where technology integration is essential.

From a pedagogical perspective, the effectiveness of the application can be explained through the principles of technology-enhanced assessment, which emphasize automation, real-time feedback, and data-driven evaluation processes [9]. The automated scoring feature reduces the likelihood of human error and accelerates the assessment cycle, enabling teachers to obtain accurate results more efficiently. This is particularly relevant in Physical Education, where cognitive assessment often complements practical performance evaluation.

Compared to conventional paper-based assessment methods, the developed system offers several significant advantages. First, it improves accessibility, as students can complete assessments anytime and anywhere using digital devices. Second, it enhances accuracy and consistency, as scoring is conducted automatically by the system. Third, it supports immediate feedback, allowing students to identify their strengths and weaknesses promptly. These features are consistent with findings from previous studies indicating that digital assessment platforms improve both efficiency and learning outcomes [2], [3].

In addition, the integration of structured question banks and exam management tools contributes to more systematic assessment practices. This addresses limitations identified in earlier instruments, which often lacked automation and comprehensive data management capabilities. The present system therefore represents a significant improvement in terms of functionality and pedagogical value.

The positive impact on student motivation observed in this study can also be attributed to the interactive nature of the application. Digital environments that combine usability with engaging interfaces have been shown to increase learner participation and promote independent learning behaviors [10]. In the context of Physical Education, this is particularly important, as cognitive engagement supports students' understanding of theoretical concepts such as rules, strategies, and health-related knowledge.

Furthermore, the application facilitates teachers' ability to monitor student performance in real time. This capability supports data-driven instructional decision-making, enabling educators to identify learning gaps and adjust teaching strategies accordingly. Such practices are increasingly emphasized in modern education systems as part of the digital transformation of teaching and assessment [11].

Overall, the findings confirm that the developed web-based cognitive assessment instrument is not only technically feasible but also pedagogically effective. It provides a scalable solution for improving assessment efficiency, accuracy, and engagement in Physical Education learning environments.

5 Conclusion

This study confirms that the developed Android-based cognitive assessment instrument is a feasible and effective tool for supporting the evaluation of learning outcomes in Physical Education, Sports, and Health (PJOK) at the junior secondary level. The application demonstrated high usability and acceptance among users, and its implementation contributed to improved efficiency, accuracy, and practicality in the cognitive assessment process.

From a pedagogical standpoint, the integration of digital assessment technology enhances the quality of evaluation by enabling automated scoring, real-time feedback, and systematic data management. These features reduce administrative workload while supporting more objective and consistent assessment practices. Such findings are consistent with recent studies highlighting the role of digital tools in optimizing assessment systems and promoting data-driven decision-making in education [1], [2].

In the context of Physical Education, where cognitive understanding complements psychomotor performance, the use of application-based assessment provides an effective mechanism for measuring students' theoretical knowledge alongside practical competencies. Therefore, the developed instrument offers a scalable and innovative solution for improving assessment practices, particularly for Grade VIII students at SMP Negeri 1 Galang.

Future research is recommended to expand the implementation of this system across broader educational settings and to examine its long-term impact on student learning outcomes, engagement, and feedback quality.

Acknowledgments. The authors would like to express their sincere appreciation to Universitas Negeri Medan (UNIMED) for its institutional support in facilitating this study. Gratitude is also extended to colleagues and academic peers who provided valuable insights and constructive feedback throughout the research process. Their contributions have significantly enhanced the conceptual clarity and academic quality of this work.

Disclosure of Interests. The authors declare that there are no competing interests associated with this study. The research was conducted independently, without any financial or commercial relationships that could be interpreted as a potential conflict of interest.

References

1. S. Siregar, I. Kasih, and H. Pardilla, "The effectiveness of e-learning-based volleyball service video media on students affected by COVID-19," *Teoriâ ta Metodika Fizičnogo Vihovannâ*, vol. 22, no. 1, pp. 7–13, 2022. <https://doi.org/10.17309/tmfv.2022.1.01>
2. P. Djuwita, "Training on the development of attitude assessment instruments during home-based learning," *Jurnal Abdi Pendidikan*, vol. 1, no. 2, pp. 82–91, 2020.
3. R. L. Nahak, "Development of cognitive diagnostic assessment based on local wisdom of the Ende Lio community," *Edukatif: Jurnal Ilmu Pendidikan*, vol. 6, no. 5, pp. 5825–5835, 2024. <https://doi.org/10.31004/edukatif.v6i5.7562>

4. D. Suprapti and A. R. Ridho, "Diagnostic assessment as a learning evaluation in the Merdeka Curriculum," *Katalis Pendidikan: Jurnal Ilmu Pendidikan dan Matematika*, vol. 1, no. 2, pp. 253–263, 2024. <https://doi.org/10.62383/katalis.v1i2.447>
5. D. Iriyadi, "Diagnostic test instruments as a basis for remedial learning," *JISAE: Jurnal Indonesian Student Assessment and Evaluation*, vol. 7, no. 1, pp. 45–54, 2021. <https://doi.org/10.21009/jisae.v7i1.20613>
6. F. Trinovitasari, H. T. M. S. Maria, and M. M. S. Hidayatullah, "Development of diagnostic tests using the testlet model to identify students' learning difficulties on momentum and impulse," *Variabel*, vol. 5, no. 2, pp. 57–64, 2022. <https://doi.org/10.26737/var.v5i2.3091>
7. S. Sulaiman, T. Tukiyyat, and A. Hindasyah, "Analysis of computer-based test applications using the DeLone and McLean model," *Jurnal Impresi Indonesia*, vol. 2, no. 1, pp. 58–70, 2023. <https://doi.org/10.58344/jii.v2i1.2010>
8. I. D. G. P. Wirayasa, I. P. Darmayasa, and I. M. Satyawan, "Development of cognitive learning outcome assessment instruments using the 4D model in football material," *Jurnal Pendidikan Jasmani, Olahraga dan Kesehatan Undiksha*, vol. 8, no. 3, pp. 81–88, 2021. <https://doi.org/10.23887/jjp.v8i3.33760>
9. D. D. Prasetya, *Developing Multiplatform Smartphone Applications*. Jakarta, Indonesia: PT Elex Media Komputindo, 2013.
10. A. A. Huda, *LiveCoding! Developing Android Applications*. Yogyakarta, Indonesia, 2014.
11. S. Siregar, H. Pardilla, N. Hasibuan, M. Fahmi, I. Kasih, and E. Faridah, "Enhancing refereeing skills: The influence of an Android-based table tennis application on student referees," *Retos*, vol. 66, pp. 75–85, 2025. <https://doi.org/10.47197/retos.v66.112160>

Open Access This chapter is licensed under the terms of the Creative Commons Attribution-NonCommercial 4.0 International License (<http://creativecommons.org/licenses/by-nc/4.0/>), which permits any noncommercial use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this chapter are included in the chapter's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.

