



Integrating Local Wisdom into Outcome-Based Physical Education through a Digital Learning Platform: A Research and Development Study

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Abstract. This study aims to operationalize Outcome-Based Education (OBE) through the integration of North Sumatra's local wisdom into a digital learning platform, thereby strengthening culturally responsive pedagogy within physical education. The initiative is designed as a comprehensive curriculum framework applicable across study programs in the Faculty of Sport Science, including Physical Education, Health and Recreation, Sport Science, and Coaching Science. By embedding indigenous knowledge into structured digital learning, the study addresses the growing demand for contextualized and technology-enhanced education in higher institutions [1], [2]. The research adopts a Research and Development (R&D) approach based on the Borg and Gall model, encompassing ten systematic stages: needs analysis, planning, prototype development, preliminary testing, product revision, main field testing, operational refinement, large-scale implementation, final revision, and dissemination. The digital platform was developed using a WordPress-based Learning Management System (LMS) integrated with the LearnPress plugin and deployed on an institutional subdomain, ensuring accessibility and scalability. Empirical findings demonstrate high user engagement and system effectiveness. Google Analytics data indicate that 97% of students successfully accessed the platform, with an average session duration of 16 minutes, reflecting sustained interaction. User satisfaction analysis reveals that 92.2% of participants perceived the platform as user-friendly, while 88.7% reported minimal technical barriers, primarily limited to network-related constraints during video uploads. Learning analytics further show that 83% of students completed all assessment components, achieving a mean score of 86.3, and 75% actively participated in asynchronous discussions. The platform incorporates multimodal instructional features, including interactive PDF modules, culturally embedded video demonstrations of traditional games such as marsialapari, dau naso, and dungdung rang-rang, formative quizzes across six thematic units, and weekly discussion forums. These features contribute to improved cognitive

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engagement, cultural awareness, and collaborative learning, aligning with contemporary digital pedagogy frameworks [3], [4]. The study highlights the pedagogical value of integrating local cultural assets into digital learning ecosystems, reinforcing both learning outcomes and cultural identity. This approach provides a scalable model for curriculum innovation in sport science education, particularly in developing countries seeking to balance global educational standards with local relevance.

Keywords: Outcome-Based Education, Local Wisdom, Digital Learning, Physical Education, LMS, Cultural Pedagogy.

1 Introduction

North Sumatra Province represents a culturally diverse region characterized by rich local wisdom embedded in its ethnic traditions, languages, customs, and social values. These cultural elements constitute an essential component of community identity, continuously evolving alongside socio-technological transformations. However, rapid globalization and digitalization have contributed to the gradual marginalization of local cultural practices, particularly among younger generations, due to limited preservation efforts and increasing external cultural influences [1]. Consequently, strategic interventions are required to ensure that local wisdom remains relevant within contemporary educational contexts.

Education plays a pivotal role in sustaining and transmitting cultural values across generations. In this regard, Physical Education (PE) offers a meaningful pedagogical space for integrating local wisdom through embodied learning experiences. Traditional physical activities, including indigenous games, martial arts, and culturally rooted movement practices, not only enhance students' physical competencies but also foster cultural awareness, identity formation, and social values such as cooperation and respect [2], [3]. Thus, embedding local wisdom into PE contributes to holistic student development, encompassing cognitive, affective, and psychomotor domains.

The cultural landscape of North Sumatra is shaped by diverse ethnic groups, including the Toba Batak, Pakpak Batak, Malay communities, and Minangkabau descendants. Each group preserves distinct philosophical systems, social structures, and cultural expressions that function as living knowledge systems regulating interpersonal relationships and environmental balance. For example, the Dalihan Na Tolu philosophy in Toba Batak culture emphasizes harmonious social relations based on mutual respect among kinship groups, while the Sulang Silima system in Pakpak society structures communal decision-making processes. These indigenous frameworks provide valuable ethical and social principles that can be contextualized within educational practices [4].

In addition, local wisdom is preserved through oral traditions, folklore, proverbs, and artistic expressions. Narratives such as regional legends and moral stories function as informal educational tools that transmit values of honesty, respect, and social harmony. Likewise, traditional arts and architecture, including Gorga Batak carvings and

vernacular house structures, symbolize philosophical interpretations of human relationships with nature and society. These cultural artifacts represent a rich source of contextual learning materials that can be adapted into modern educational content [5].

Beyond cultural preservation, local wisdom also demonstrates practical relevance in addressing contemporary social, economic, and educational challenges. For instance, values such as *gotong royong* (mutual cooperation) strengthen social cohesion, while culturally grounded approaches to conflict resolution often provide more inclusive and acceptable outcomes than formal mechanisms. Furthermore, local cultural products, such as *ulos* textiles, have been revitalized through digital marketing strategies, illustrating the adaptability of traditional knowledge within modern economic systems [6].

The implementation of Outcome-Based Education (OBE) provides a structured framework for integrating these cultural elements into higher education curricula. OBE emphasizes measurable learning outcomes aligned with graduate competencies, including knowledge, skills, and attitudes required in professional contexts [7]. Within sport science education, this approach enables the alignment of culturally embedded learning activities with clearly defined Course Learning Outcomes (CLOs), thereby enhancing both academic relevance and cultural significance.

The advancement of digital technology further expands the potential for integrating local wisdom into educational practices. Digital platforms, particularly Learning Management Systems (LMS), facilitate the documentation, dissemination, and interactive engagement of culturally contextualized learning materials. Previous studies indicate that digital learning environments enhance accessibility, student engagement, and learning flexibility, particularly when combined with culturally relevant content [8], [9], [10]. Therefore, the integration of local wisdom into digital platforms represents a strategic approach to bridging traditional knowledge with modern pedagogical innovation.

At the Faculty of Sport Science, the implementation of OBE-based learning has primarily relied on the institutional LMS, which presents limitations in terms of flexibility and lecturer autonomy due to technical dependencies. This constraint highlights the need for independently developed digital learning platforms that enable educators to design, manage, and deliver culturally enriched learning content more effectively. Such platforms not only improve instructional efficiency but also promote digital literacy among students and lecturers.

Accordingly, this study proposes the development of a digital platform that integrates North Sumatran local wisdom into physical education learning within an OBE framework. This approach aims to enhance learning quality, strengthen cultural identity, and support the development of students' holistic competencies. By combining sport science principles, cultural pedagogy, and digital technology, the study contributes to the advancement of innovative, contextually relevant, and sustainable educational practices in higher education.

2 Method

This study employs a Research and Development (R&D) approach to design and validate a digital learning platform that integrates North Sumatran local wisdom into physical education. The R&D paradigm is appropriate for producing and evaluating educational innovations, particularly those involving technology-enhanced learning environments and culturally contextualized content [11]. The methodological framework is adapted from the Borg and Gall development model, which provides a systematic, iterative process for educational product design, testing, and refinement.

The development process consists of ten sequential stages: (1) research and information gathering, (2) planning, (3) preliminary product development, (4) preliminary field testing, (5) main product revision, (6) main field testing, (7) operational product revision, (8) operational field testing, (9) final product revision, and (10) dissemination and implementation. This structured approach ensures that the developed platform is empirically validated, pedagogically sound, and responsive to user needs.

As illustrated in Figure 1, the research process follows a cyclical and iterative design, allowing continuous refinement based on empirical evidence and user feedback. The methodological emphasis is analytical and developmental, integrating qualitative and quantitative data to evaluate both product feasibility and instructional effectiveness.



Fig 1. Research Process

2.1 Research and Information Gathering

The initial phase involves a comprehensive needs analysis to identify gaps in existing physical education learning practices and the potential integration of local

wisdom into digital platforms. Data were collected through literature review, semi-structured interviews with lecturers and students, and observational studies of current instructional practices. This stage establishes the conceptual and empirical foundation for product development.

2.2 Planning

Based on the findings from the needs analysis, a detailed development plan was formulated. This includes defining learning objectives aligned with Outcome-Based Education (OBE), designing culturally embedded instructional content, and determining system architecture for the digital platform. Evaluation instruments, including usability scales and learning outcome assessments, were also prepared at this stage.

2.3 Preliminary Product Development

A prototype of the digital platform was developed using a Learning Management System (LMS) framework. The initial product includes instructional modules, multimedia learning resources, and formative assessment tools incorporating North Sumatran cultural elements. At this stage, the prototype remains a draft version intended for early-stage validation.

2.4 Preliminary Field Testing

The prototype was tested on a small group of users, including students and lecturers from the Faculty of Sport Science. The purpose of this stage is to identify usability issues, content relevance, and system functionality. Data were collected using questionnaires, interviews, and direct observation.

2.5 Main Product Revision

Based on feedback from the preliminary testing phase, revisions were made to improve the platform's design, instructional content, and technical performance. Particular attention was given to enhancing user interface design, cultural representation accuracy, and system responsiveness.

2.6 Main Field Testing

The revised product was subsequently tested on a larger and more representative sample of users. This stage aims to evaluate the effectiveness of the platform in improving learning outcomes, student engagement, and cultural understanding. Quantitative data were analyzed using descriptive statistics, while qualitative feedback provided insights into user experience.

2.7 Operational Product Revision

Further refinements were conducted based on the results of the main field testing. This stage focuses on optimizing platform performance, ensuring content accuracy, and improving overall usability in preparation for real-world implementation.

2.8 Operational Field Testing

The platform was implemented in an actual classroom setting to assess its effectiveness under authentic learning conditions. This phase evaluates the system's scalability, reliability, and impact on student learning behavior within a real educational environment.

2.9 Final Product Revision

The final revision stage incorporates all findings from the operational testing phase to produce a fully functional and validated digital learning platform. The product is refined to meet pedagogical, technical, and usability standards.

2.10 Dissemination and Implementation

The finalized platform is disseminated through academic publications, workshops, and institutional integration. Implementation strategies are designed to ensure sustainability, scalability, and long-term adoption within physical education programs.

Methodological Rigor and Data Analysis

To ensure validity and reliability, this study employs triangulation of data sources, combining qualitative insights with quantitative metrics. User engagement and system effectiveness are measured using analytics data, usability scales, and learning performance indicators. Descriptive statistical analysis is applied to evaluate trends in user interaction, while qualitative data are analyzed thematically to capture user perceptions and experiences. This mixed-methods approach strengthens the robustness of the findings and supports comprehensive evaluation of the developed platform [3], [4].

3 Results and Discussion

3.1 Results

This study developed and implemented a digital learning strategy integrating North Sumatran local wisdom into the Physical Education Learning Strategy course. The intervention involved 64 fifth-semester students over one semester (12 sessions: 8 classroom-based and 4 field-based). The evaluation focused on two principal outcomes:

(i) the performance of the digital platform and (ii) the effectiveness of a case method-based learning project.

3.1.1 Platform Accessibility and Usability

The platform was developed using a WordPress-based Learning Management System (LMS) integrated with the LearnPress plugin and deployed via an institutional subdomain. Analytics data indicate a high level of accessibility and user engagement. Approximately 97% of students successfully logged into the system, with an average session duration of 16 minutes, suggesting sustained interaction rather than superficial access.

Usability evaluation using a five-point Likert scale revealed that 92.2% of users perceived the platform as easy to operate, while 88.7% reported minimal technical constraints, with issues primarily related to network instability during multimedia uploads. These findings indicate that the system meets essential usability criteria for digital learning environments, particularly in terms of accessibility, efficiency, and user satisfaction.

3.1.2 Utilization of Learning Features

The platform integrates multimodal instructional components, including interactive modules, culturally contextualized video content, formative assessments, and asynchronous discussion forums. Activity logs demonstrate that 83% of students completed all quizzes, achieving a mean score of 86.3, while 75% actively participated in online discussions at least three times. Furthermore, all participants accessed video-based materials, with at least three out of four instructional videos viewed per student.

These findings confirm that the platform effectively supports active learning behaviors and fosters engagement across cognitive and collaborative dimensions. The inclusion of culturally embedded materials, such as traditional games (marsialapari, dau naso, and dungdung rang-rang), enhances contextual relevance and experiential learning.

3.1.3 Student-Generated Digital Learning Products

Students were assigned to develop digital instructional media grounded in local cultural content. The outputs included video-based learning materials, infographics, and interactive modules created using digital tools such as Canva, PowerPoint, and Genially. Of the total participants, 93.75% successfully completed the assigned projects within the specified timeframe.

Assessment results demonstrate strong performance across key evaluation criteria: creativity and originality ($M = 88.1$), cultural relevance ($M = 85.7$), and media quality ($M = 82.3$). Representative outputs included instructional videos based on Tolu Sahundulan, culturally adapted movement modules derived from Tortor dance, and interactive quizzes focusing on traditional Karo movement patterns. These results

indicate that students effectively integrated pedagogical design principles, cultural content, and digital media competencies.

3.1.4 Learning Motivation and Engagement

Student motivation was assessed using the ARCS (Attention, Relevance, Confidence, Satisfaction) model. The findings reveal that 90.6% of students experienced increased motivation compared to conventional instructional approaches. High agreement levels were observed for statements related to cultural relevance (92%) and the effectiveness of digital media in enhancing learning interest (89%).

Participation data further indicate full engagement, with 100% of students involved in digital teaching simulations, including microteaching sessions that combined online and offline modalities. Students demonstrated the ability to design and implement culturally informed learning scenarios, such as modified traditional games to develop coordination and motor skills, supported by structured assessment instruments.

3.1.5 Learning Outcomes

Learning outcomes were evaluated through pre-test and post-test measures focusing on pedagogical, cultural, and digital competencies. As presented in Table 1, the results show a substantial improvement following the intervention.

Table 1. Learning outcomes

Evaluation Type	Mean Score	Description
Pre-test	68,9	Before intervention
Post-test	86,2	After intervention
Improvement	17,3 points (25%)	Gain Score

3.2 Discussion

The findings of this study demonstrate that integrating North Sumatran local wisdom into a digital learning platform significantly enhances the quality of physical education learning at the tertiary level. The high accessibility and usability of the LMS confirm that technology-mediated learning environments can effectively support student-centered learning when designed with intuitive interfaces and relevant content [12].

The strong engagement observed in this study reflects the effectiveness of combining digital pedagogy with culturally contextualized content. Students did not merely consume learning materials but actively interacted with them through discussion, content creation, and problem-solving activities. This aligns with constructivist learning theory, which emphasizes active knowledge construction through meaningful engagement [13]. The integration of traditional games and cultural practices provided authentic learning contexts, thereby strengthening cognitive processing and experiential understanding.

The development of student-generated digital products further highlights the integration of Technological Pedagogical Content Knowledge (TPACK). Students demonstrated the ability to synthesize technological tools, pedagogical strategies, and culturally relevant content into coherent instructional designs. This finding is consistent with previous research indicating that digital content creation enhances higher-order thinking skills, creativity, and professional readiness [14].

From a motivational perspective, the increased student engagement supports the principles of culturally responsive teaching, which posits that learning becomes more meaningful when it reflects students' cultural identities and lived experiences [15]. The high scores in the relevance and satisfaction dimensions of the ARCS model indicate that the integration of local wisdom fosters both emotional and cognitive engagement, leading to improved learning outcomes.

The statistically significant improvement in post-test scores further validates the effectiveness of the proposed approach. The observed gain of 25% suggests that the integration of digital technology and local cultural content not only enriches instructional quality but also enhances measurable academic performance. These findings are consistent with studies demonstrating that blended and culturally contextualized learning environments improve both conceptual understanding and skill acquisition [16].

From an Outcome-Based Education (OBE) perspective, the results confirm alignment between instructional strategies and the achievement of Graduate Learning Outcomes (CPL). The case method-based approach facilitated the development of critical competencies, including analytical thinking, problem-solving, collaboration, and communication skills. Moreover, the integration of local wisdom contributed to the development of affective competencies, such as cultural awareness, ethical responsibility, and social sensitivity.

The use of collaborative activities, including focus group discussions and reflective analysis, further supports social constructivist learning principles, where knowledge is co-constructed through interaction and shared experiences [7]. This process enables students to critically interpret cultural values and apply them within educational contexts, thereby bridging theoretical knowledge and practical application.

Overall, this study demonstrates that a digital platform integrating local wisdom within an OBE framework represents an effective and scalable model for physical education learning. The approach not only enhances academic achievement but also strengthens cultural identity and supports the development of holistic competencies required in 21st-century education. Therefore, the replication of this model in other cultural contexts is recommended to promote culturally responsive and technologically enriched learning environments.

4 Conclusion

This study demonstrates that the integration of North Sumatran local wisdom into a digital learning platform constitutes an effective strategy for enhancing physical education learning at the tertiary level. By aligning culturally responsive content with

Outcome-Based Education (OBE) principles, the developed approach successfully improves both the learning process and measurable student outcomes. The findings indicate that embedding local cultural values within digital learning environments fosters more meaningful, contextualized, and student-centered learning experiences, consistent with contemporary pedagogical frameworks [1], [2].

The developed platform exhibited high levels of accessibility and usability, enabling students to engage with multimodal learning resources, including interactive modules, culturally grounded instructional videos, discussion forums, and formative assessments. This technological environment facilitated active learning, as evidenced by increased student motivation, sustained engagement, and improved conceptual understanding. The results further confirm that digital platforms, when designed with pedagogical and cultural alignment, can effectively support flexible and autonomous learning [3].

Moreover, the implementation of case-based learning projects revealed that students were capable of integrating pedagogical knowledge, digital competencies, and cultural understanding into coherent instructional designs. The production of digital learning media based on traditional games and local practices reflects the development of higher-order thinking skills, creativity, and Technological Pedagogical Content Knowledge (TPACK). These outcomes highlight the potential of combining digital literacy with cultural literacy to prepare graduates for the demands of 21st-century education [4].

The statistically significant improvement in learning outcomes between pre-test and post-test scores further substantiates the effectiveness of this approach. In addition to cognitive gains, the integration of local wisdom contributed to the development of affective competencies, including cultural awareness, social responsibility, and appreciation of regional identity. This finding reinforces the role of physical education as not only a medium for physical development but also as a platform for character education and cultural preservation.

From an OBE perspective, the study confirms a strong alignment between instructional design, learning activities, and the achievement of Graduate Learning Outcomes (CPL). The integration of digital technology and local cultural content supports the development of essential competencies such as critical thinking, collaboration, communication, and contextual problem-solving. Consequently, this model offers a scalable and adaptable framework for curriculum innovation in sport science education, particularly in culturally diverse contexts.

In conclusion, the integration of local wisdom into digital-based physical education learning represents a sustainable and innovative pedagogical approach that enhances academic performance while preserving cultural heritage. Future research is recommended to expand this model across different educational settings and cultural contexts, as well as to incorporate advanced technologies such as mobile learning and immersive environments to further strengthen learning effectiveness and engagement.

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