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DESIGN AND EVALUATION OF A FLIPHTML5-BASED E-MODULE SYSTEM FOR ENHANCING HIGHER-ORDER THINKING SKILLS IN PHYSICAL EDUCATION TO SUPPORT SUSTAINABLE DEVELOPMENT GOALS (SDGS)

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Abstract

The development of higher-order thinking skills (HOTS) in physical education requires digital learning systems that support higher-level cognitive processes and authentic problem-solving activities. This study reports the design and evaluation of a FlipHTML5-based e-module system developed to enhance HOTS in physical education through a problem-based learning (PBL) approach, contributing to the Sustainable Development Goals (SDGs), particularly SDG 4 (Quality Education). A research and development methodology using the 4D model (define, design, develop, and disseminate) was employed. The system integrates sport edupreneurship content, local contextual values, and HOTS-oriented assessment instruments to support analysis, evaluation, and creation skills. Validation results indicate that the developed e-module meets validity, practicality, and reliability criteria. Empirical testing shows that the e-module effectively improves students' HOTS compared to conventional learning practices. The findings demonstrate that the FlipHTML5-based e-module system provides an effective and scalable digital learning solution for implementing HOTS-oriented and problem-based physical education aligned with sustainable educational development.

Keywords: Education, E-module, Higher order thinking skills, Problem based learning, Sports education.

1. Introduction

The development of higher-order thinking skills (HOTS) has become a central focus in contemporary education, including physical education, as these skills enable learners to analyse problems, evaluate solutions, and generate creative ideas in real-world contexts [1, 2]. Many reports regarding physical education have been well-documented [3-7]. However, learning and assessment practices in physical education are still largely dominated by procedural activities and low-level cognitive evaluation. Many teachers experience difficulties in designing holistic assessment instruments that not only measure learning outcomes but also actively stimulate students' higher-order cognitive processes [8-10].

Advances in digital learning technologies provide opportunities to address these challenges through system-based instructional solutions. Web-based learning environments and digital e-modules allow learning materials, activities, and assessments to be integrated into interactive systems that support reflection, inquiry, and critical thinking [11, 12]. Platforms such as FlipHTML5 enable the development of digital e-modules with multimedia integration, interactive navigation, and flexible access across devices. When designed as a learning system rather than a static presentation tool, digital e-modules can support structured learning processes and HOTS-oriented assessment mechanisms [13, 14].

The Problem-Based Learning (PBL) model has been widely recognized as an effective instructional approach for promoting active learning, collaboration, and critical thinking. By engaging students with authentic and contextual problems, PBL encourages analysis, reasoning, and decision-making processes that align directly with HOTS development [15]. However, the success of PBL is not solely determined by the learning model itself, but also by how assessment and feedback are implemented throughout the learning process [16]. Without appropriate digital learning systems that guide learning activities and provide meaningful feedback, the potential of PBL to foster higher-order thinking may not be optimally realized [17-19].

In physical education, the integration of sport edupreneurship concepts strengthens learning relevance by connecting instructional content with creativity, entrepreneurship, and real-world applications. Embedding local values and contextual issues into digital learning systems can enhance student motivation and engagement, making learning more meaningful [20, 21]. The conceptual framework of this study, illustrated in Fig. 1, shows the integration of a FlipHTML5-based e-module system, Problem-Based Learning, sport edupreneurship content, and HOTS-oriented assessment within a unified digital learning environment.

Furthermore, the development of scalable and accessible digital learning systems aligns with the Sustainable Development Goals (SDGs), particularly SDG 4 (Quality Education), which emphasizes inclusive, equitable, and high-quality education supported by effective learning technologies [22]. In response, this study aims to design and evaluate a FlipHTML5-based e-module system for enhancing HOTS in physical education through a PBL approach. The novelty of this research lies in positioning FlipHTML5 as a system-level digital learning solution, integrating HOTS-oriented assessment with sport edupreneurship content, and aligning digital learning innovation with SDG-oriented educational goals.

Fig. 1. Overview of the concept of this research.

2. Methodology

This study employed a Research and Development (R&D) approach using the 4D model (Define, Design, Develop, Disseminate). The Define stage identified learning needs, student characteristics, curriculum demands, and HOTS-oriented assessment issues in physical education. The Design stage developed a FlipHTML5-based e-module system integrating PBL and sport edupreneurship content. During the Develop stage, the e-module was produced and validated by experts in content, design, and language. The Disseminate stage involved limited field implementation with undergraduate students. Data were collected through validation instruments, student response questionnaires, and HOTS assessments to evaluate the system's validity, practicality, and effectiveness. Detailed R&D procedures are reported elsewhere [23]

3. Results and Discussion

This study aimed to design and evaluated a FlipHTML5-based e-module system integrating sport edupreneurship and PBL to enhance HOTS in physical education. The overall research framework and conceptual integration are illustrated in Fig. 1, which presents the relationship between digital e-modules, PBL, HOTS-oriented assessment, and learning outcomes. The results are discussed in terms of system design quality, instrument validity, and learning effectiveness.

The development process followed the 4D model, ensuring systematic alignment between learning objectives, digital system design, and HOTS-oriented assessment. The resulting FlipHTML5-based e-module system was designed to support reflective, interactive, and problem-based learning activities. The system architecture, presented in Fig. 2, demonstrates how learning content, assessment tasks, and feedback mechanisms are integrated to encourage students' active engagement and higher-order cognitive processes.

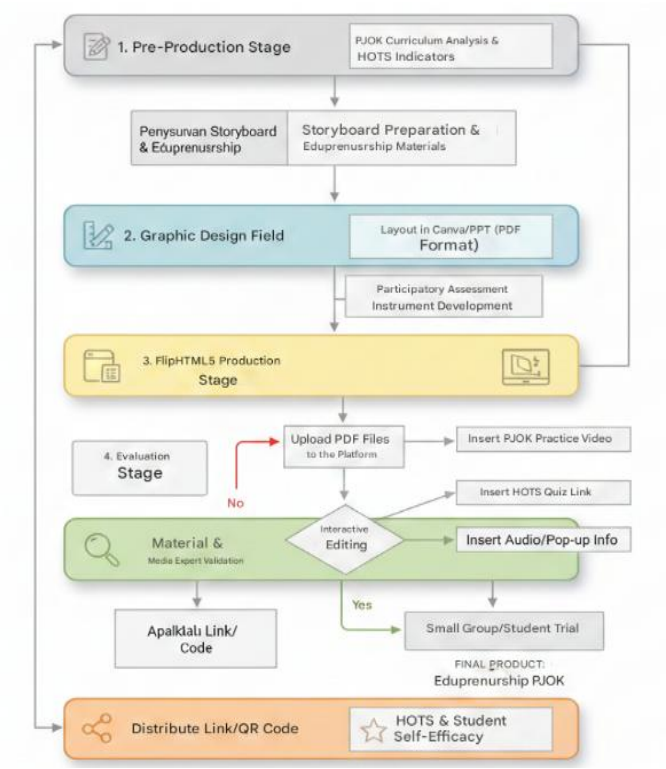

Fig. 2. Flowchart for develop e-module.

The visual interface and accessibility of the e-module are shown in Figs. 3(a) and 3(b), respectively, illustrating the usability of the system across devices, including Android-based platforms. These design features are consistent with previous findings that digital and interactive learning media can enhance student engagement and cognitive involvement [11, 13, 24]. The integration of sport edupreneurship content further contextualizes learning by linking physical education concepts with entrepreneurial values, making learning more relevant and meaningful for students [20, 21].

(a) **(b)**

Fig 3. (a) The first pages of the e-module using FlipHTML5 and (b) E-module display in android.

The validation results indicate that the developed e-module system meets high validity standards. Expert evaluations of content suitability, construct feasibility, and language clarity resulted in average validity scores above accepted thresholds, confirming that the system is appropriate for HOTS development. Reliability analysis also showed strong internal consistency, with a reliability coefficient of 0.770, indicating that the assessment instruments embedded in the system are stable and dependable. These findings align with prior research emphasizing the importance of well-designed assessment tools in supporting higher-order cognitive skills [8-10].

The practicality of the system was reflected in positive user responses. Students reported that the FlipHTML5-based e-module was easy to navigate and supported independent learning through interactive tasks, self-assessment, and peer assessment activities. The presence of structured feedback mechanisms allowed students to identify strengths and weaknesses in their reasoning processes, reinforcing reflective learning practices [19, 25].

The operational features of the system are depicted in Fig. 4, which shows the finalized e-module layout and learning flow. This figure illustrates the structure and functionality of the FlipHTML5-based e-module system, including introductory content (Fig. 4(a)), learning objectives and conceptual overview (Fig. 4(b)), contextual problem scenarios (Fig. 4(c)), main menu and navigation interface (Fig. 4(d)), interactive learning content (Fig. 4(e)), sport edupreneurship business opportunity analysis (Fig. 4(f)), multimedia-based learning resources (Fig. 4(g)), and HOTS-oriented problem-based learning and assessment activities (Fig. 4(h)).

The effectiveness analysis demonstrates that the FlipHTML5-based e-module system significantly improves students' HOTS. Students showed increased performance in analytical, evaluative, and creative thinking tasks, consistent with Bloom's higher cognitive levels (C5-C7). These results support previous studies indicating that Problem-Based Learning environments, when supported by digital assessment systems, foster critical and creative thinking [2, 15].

The integration of Assessment as Learning within the e-module enables students to actively participate in the evaluation process, enhancing metacognitive awareness and self-regulation [1, 13]. This approach addresses previously identified gaps in physical education assessment practices, where evaluation often focuses only on low-level cognitive outcomes [12, 14].

From a broader perspective, the developed e-module system contributes directly to SDG 4 (Quality Education) by promoting inclusive, equitable, and technology-enhanced learning that emphasizes higher-order cognitive development. By integrating digital learning systems, entrepreneurial values, and HOTS-oriented assessment, the system supports lifelong learning competencies such as critical thinking, creativity, and problem solving. Additionally, the incorporation of sport edupreneurship aligns with SDG 8 (Decent Work and Economic Growth) by fostering entrepreneurial awareness and skills relevant to the sports industry and future employment contexts. The results confirm that the FlipHTML5-based e-module system is a valid, practical, and effective digital learning solution that enhances HOTS in physical education while supporting sustainable educational development goals.

(a) (b) (c)

(d) (e) (f)

(g) (h)

Fig 4. E-module using FlipHTML5 Sport Edupreneurship:
(a) Introductory page of sport edupreneurship concept,
(b) Learning objectives and conceptual overview,
(c) Contextual problem scenarios in sport edupreneurship,
(d) Main menu and navigation interface,
(e) Interactive learning content and conceptual explanation,
(f) Business opportunity analysis in sport edupreneurship,
(g) Multimedia-based learning resources (video and digital content), and
(h) PBL activities and HOTS-oriented assessment tasks.

4. Conclusion

This study demonstrates that the FlipHTML5-based e-module system integrated with PBL and sport edupreneurship is valid, practical, and effective in enhancing HOTS in physical education. The system supports analytical, evaluative, and creative thinking through interactive digital content, reflective assessment, and structured feedback mechanisms. The results confirm that technology-supported assessment and learning design can address limitations in conventional physical education evaluation practices. Furthermore, the developed system contributes to SDG 4 (Quality Education) by promoting inclusive, technology-enhanced learning, and supports SDG 8 (Decent Work and Economic Growth) by fostering entrepreneurial competencies relevant to future professional contexts.

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