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DESIGN AND EVALUATION OF A WEB-BASED ASSESSMENT-AS-LEARNING SYSTEM INTEGRATED WITH PROBLEM-BASED LEARNING AND LOCAL WISDOM TO ENHANCE CREATIVE THINKING SKILLS FOR SUSTAINABLE DEVELOPMENT GOALS (SDGS)

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Abstract

This study reports the design and evaluation of a web-based assessment-as-learning system integrated with problem-based learning (PBL) and local wisdom (Lemang) to enhance students' creative thinking skills in physics learning. The system was developed using a research and development approach based on the 4D model, including define, design, develop, and disseminate stages. The assessment system enables students to actively engage in self-assessment and peer assessment processes, encouraging reflection, feedback, and continuous learning improvement. Validation results indicate that the system meets the criteria of validity, practicality, and reliability, while effectiveness testing shows a moderate improvement in students' creative thinking skills, supported by NGain analysis. The integration of Lemang contextualizes physics concepts within students' cultural environment, increasing engagement and relevance. This study contributes to Sustainable Development Goals (SDGs), especially SDG4 (Quality Education), by promoting inclusive, technology-enhanced assessment practices and SDG 11 (Sustainable Communities) through the integration of local cultural knowledge into digital learning systems.

Keywords: Creativity, Creative thinking skills, Lemang, Problem based learning, Web based assessment as learning.

1. Introduction

The rapid integration of digital technology in education has transformed assessment practices from static measurement tools into dynamic learning mechanisms [1-5]. One approach that has gained increasing attention is assessment as learning, which positions assessment as an active process where students reflect on their understanding, monitor progress, and regulate learning strategies [6]. Web-based platforms further strengthen this approach by enabling continuous access to assessment tasks, immediate feedback, and data-driven learning support, fostering learner autonomy and metacognitive awareness [7].

In physics education, assessment as learning plays a critical role in promoting creative thinking skills, which are essential for problem solving, conceptual reasoning, and innovation. However, many classroom assessments remain focused on low-level cognitive outcomes, emphasizing recall and routine procedures while neglecting opportunities for creativity and reflection [8]. This gap contrasts with the demands of the Independent Curriculum, which emphasizes holistic, formative, and summative assessments that foster higher-order and creative thinking skills. Consequently, there is a strong need for assessment systems that actively engage students in the evaluation process while supporting meaningful learning experiences.

Problem-Based Learning (PBL) has been widely recognized as an effective instructional approach for enhancing student engagement, critical thinking, and creativity by situating learning in authentic problem contexts [9, 10]. Nevertheless, the success of PBL is closely tied to the quality of assessment practices embedded within the learning process. Without appropriate assessment mechanisms, the potential of PBL to foster creative thinking may not be fully realized [11]. Integrating assessment as learning into PBL through web-based systems offers a promising solution by enabling continuous feedback, self-assessment, and peer assessment aligned with real-world problem solving.

To enhance relevance and contextual understanding, the integration of local wisdom, such as Lemang, provides a culturally meaningful framework for physics learning. Lemang, a traditional food of the Kerinci region, involves physical concepts related to heat transfer and material processing, making it an effective contextual bridge between abstract physics concepts and students' everyday experiences [12, 13]. Embedding local wisdom within digital assessment systems not only increases student engagement but also strengthens cultural identity and learning relevance [14, 15].

Therefore, this study focuses on the design and evaluation of a web-based assessment-as-learning system integrated with Problem-Based Learning and local wisdom (Lemang) to enhance students' creative thinking skills in physics. The novelty of this research lies in: (i) the development of a web-based assessment system that positions students as active assessors of their own learning; (ii) the integration of PBL with culturally contextualized physics content; and (iii) the alignment of digital assessment practices with Sustainable Development Goals (SDGS), especially SDG4 (Quality Education) by promoting inclusive, technology-enhanced learning, as well as SDG 11 (Sustainable Communities) through the preservation and integration of local cultural knowledge into formal education.

2. Methodology

This study employed a Research and Development (R&D) approach using the 4D development model consisting of define, design, develop, and disseminate stages [16]. The development process focused on designing a web-based assessment-as-learning system integrated with Problem-Based Learning (PBL) and local wisdom (Lemang) in physics learning. The system was validated by experts to assess content relevance, construct feasibility, and language clarity. Limited field implementation was conducted with Grade XI science students at MA Negeri 1 Kerinci. Data were collected using validation instruments, student response questionnaires, and creative thinking skill assessments. System effectiveness was analysed using descriptive statistics and NGain analysis to evaluate improvements in students' creative thinking skills. Detailed R&D procedures are reported elsewhere [17].

3. Results and Discussion

The overall development framework of the system is illustrated in Fig. 1, which presents the integration between web-based assessment, PBL stages, and culturally contextualized learning activities. Preliminary analysis revealed that conventional assessment practices predominantly focused on low-level cognitive skills (C1-C3) and provided limited opportunities for student reflection and feedback, as previously reported in similar educational contexts [8]. To address this gap, the developed system embeds assessment as a learning principle, allowing students to actively engage in self-assessment and peer assessment processes. The system architecture emphasizes continuous feedback, reflective activities, and learner participation, supporting creative thinking development.

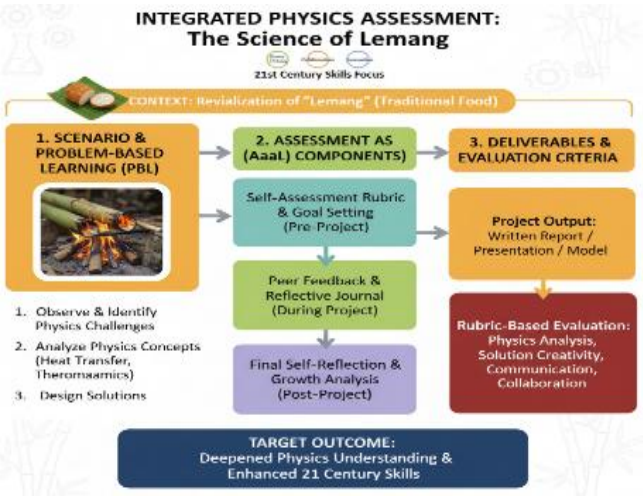

Fig. 1. Development web based assessment as learning based "Lemang".

The interface and operational features of the web-based assessment system are shown in Fig. 2. These figures illustrate the assessment e-book interface, technology-mediated assessment implementation, validation processes, and submission mechanisms. The system enables students to access assessment tasks digitally, receive

feedback, and revise their responses iteratively, which aligns with findings that web-based assessment enhances learner autonomy and metacognitive awareness [18].

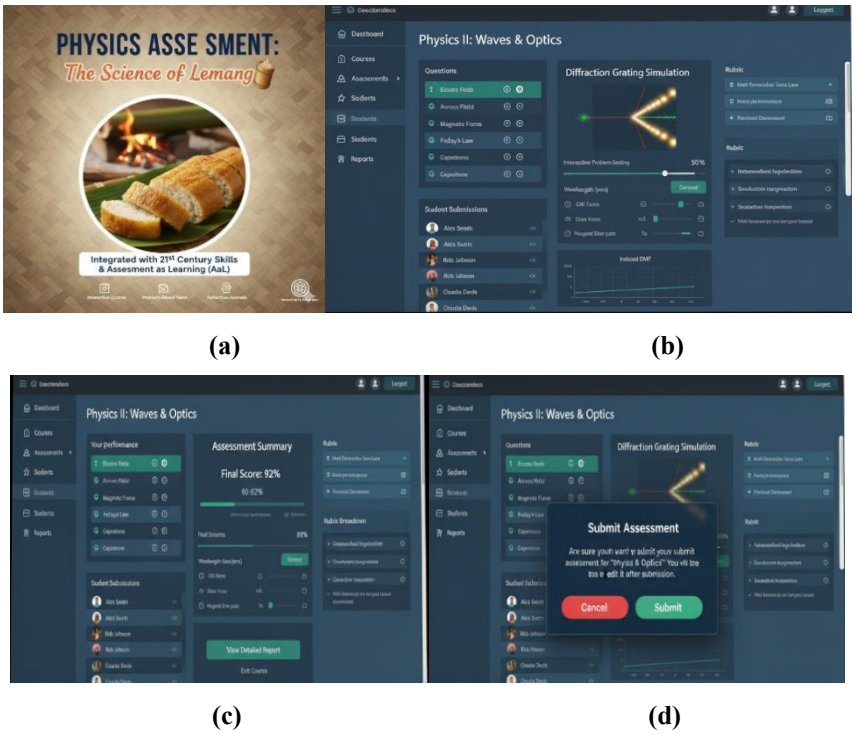

Fig. 2. (a) The first page of assessment as a learning E-book, (b) Web-based assessment as learning is done through technology media, (c) Valid web-based assessment, and (d) submitting the assessment.

Expert validation results indicate that the developed assessment instruments demonstrate strong validity across construction, content suitability, and language clarity, with average validity scores ranging from 0.75 to 0.87. Reliability analysis using Cronbach's Alpha yielded a coefficient of 0.770, confirming that the instruments are reliable and consistent. These results are consistent with prior studies emphasizing the importance of clear assessment criteria and structured rubrics in supporting assessment as learning [19].

Practicality evaluation further confirms that the system is easy to use and beneficial for both teachers and students. Teacher responses indicated high practicality scores (81.61-89.17), while student feedback highlighted improved engagement and clarity in understanding learning expectations. The teacher's guidebook, developed to support system implementation, provides structured guidance for integrating assessment as learning within PBL activities, consistent with curriculum demands [20].

Effectiveness analysis demonstrates that the web-based assessment-as-learning system contributes to a moderate improvement in students' creative thinking skills, as indicated by NGain analysis across multiple schools. Students showed notable progress in problem-solving, idea generation, and originality, exceeding the

minimum performance threshold of 75%. These findings support previous research indicating that PBL environments combined with reflective assessment practices foster creativity and higher-order thinking [11].

The integration of local wisdom (Lemang) further strengthens learning relevance by contextualizing physics concepts such as heat transfer and material processing within students' cultural experiences [12, 13]. Students reported greater motivation and engagement when learning activities were connected to familiar cultural practices, reinforcing the role of culturally responsive assessment in creative learning development [14, 15].

From a broader perspective, the developed system contributes directly to SDG 4 (Quality Education) by promoting inclusive, technology-enhanced assessment practices that emphasize creativity, reflection, and active learning. Additionally, the integration of local cultural knowledge supports SDG 11 (Sustainable Communities) by preserving and revitalizing local wisdom through formal education. By combining digital assessment, PBL, and cultural context, the system offers a scalable and sustainable model for enhancing creative thinking skills in secondary physics education. Finally, this study adds new information, especially relating to science education, as reported elsewhere (see Table 1).

Table 1. Previous studies on science education.

No	Title	Ref.
1	Competence-based educational cluster model for developing future physics teachers toward quality education to support sustainable development goals (SDGs)	[21]
2	Impact of blended learning method on secondary school physics students' achievement and retention in Lokoja, Nigeria	[22]
3	Development analysis research on physics education by mapping keywords using the VOSviewer application	[23]
4	Awareness and utilization of artificial intelligence-based intelligent tutoring systems (ITS) in enhancing chemistry education through information and communication technology (ICT)	[24]
5	Effect of conceptual change instructional strategy on chemistry students' performance in acids and bases concepts	[25]
6	Problem based learning (PBL) learning model for increasing learning motivation in chemistry subject: Literature review with bibliometric analysis	[26]
7	Learning challenges and coping strategies in chemistry among STEM and non-STEM students in the bachelor of secondary education major in science (BSEd-Science) program: A phenomenological study	[27]
8	Chemistry educators' readiness and intentions to integrate game-based software: A survey	[28]
9	Accessibility and utilization of artificial intelligence (AI)-based intelligent tutoring systems (ITS) and information and communication technology (ICT) in enhancing biology education	[29]
10	Utilization of dynamic visualization tools: Enhancing students' motivation and engagement in biology education	[30]
11	Development of an animation package in biology for teaching vertebrate, anatomy, and physiology	[31]

4. Conclusion

This study concludes that the developed web-based assessment-as-learning system integrated with PBL and local wisdom (Lemang) is valid, practical, and effective in enhancing students' creative thinking skills in physics learning. The system enables active student involvement through self-assessment, peer assessment, and continuous feedback, supporting reflective and creative learning processes. The integration of culturally contextualized content increases learning relevance and student engagement. Furthermore, the proposed system contributes to SDG4 (Quality Education) by promoting inclusive, technology-enhanced assessment practices and supports SDG11 (Sustainable Communities) through the preservation and integration of local cultural knowledge within formal education.

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