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DEVELOPING AN AI-ASSISTED LESSON PLANNING PLATFORM FOR ELEMENTARY LEARNING IN SUPPORT OF SUSTAINABLE DEVELOPMENT GOAL 4

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Abstract

This study develops a web-based platform powered by artificial intelligence to support pre-service elementary school teachers in designing curriculum-aligned teaching modules under Indonesia's Merdeka Curriculum. Using a modified Borg and Gall development model, the research followed five stages: potential and problem analysis, data collection, product design, validation, and revision. The platform enables users to input learning objectives and automatically generates structured lesson plans with appropriate content, activities, and assessments. Expert validations in media, content, and language yielded a high feasibility score, confirming the platform's effectiveness in simplifying the instructional planning process. The AI-assisted system alleviates the cognitive burden of manual formatting and fosters independent, digitally driven learning. This innovation contributes to Sustainable Development Goal 4 (Quality Education) by enhancing the instructional competence of future educators through accessible, technology-integrated tools. It represents a scalable approach to improving educational quality in teacher training programs and broader pedagogical practices.

Keywords: AI-assisted learning, Instructional design, Lesson planning automation, SDG 4, Web-based education.

1. Introduction

Effective instructional planning is essential in implementing Indonesia's Merdeka Curriculum, which emphasizes competency-based, student-centred learning [1, 2]. Teaching modules serve as structured lesson plans, yet many pre-service teachers face challenges in creating them due to limited instructional design skills, time constraints, and low digital literacy [3-5]. Digital platforms for supporting *Platform Merdeka Mengajar (PMM)* provide access to resources but often lack personalization and automation [6-8]. Prior studies focus on teacher perceptions, technical difficulties, and general platform usage without offering technological solutions for module creation. Teachers frequently download generic templates and revise them manually, which is inefficient and cognitively demanding [9-13].

This study aims to develop an artificial intelligence (AI)-assisted web-based platform that enables pre-service elementary teachers to generate structured, curriculum-aligned teaching modules automatically. AI for supporting education has been well-reported [14-19]. The novelty of this study lies in its integration of artificial intelligence into instructional planning tailored specifically for pre-service teachers.

Unlike prior platforms, this tool offers real-time AI-generated lesson structures, embedded scaffolding, and contextual prompts to support autonomous learning and pedagogical decision-making. Drawing upon the principles of instructional design science and learning technologies, this platform exemplifies the application of automation, artificial intelligence, and web-based interfaces in improving teacher education. It leverages intelligent digital tools, including Natural Language Generation (NLG), to reduce cognitive workload and enhance lesson planning precision. By embedding these innovations, the platform contributes to SDG 4 (Quality Education) and SDG 9 (Industry, Innovation, and Infrastructure), and serves as a scalable, evidence-based approach to preparing educators for technology-integrated classrooms [20].

2. Literatur Review

Effective instructional planning is essential to teacher competence and directly supports SDG 4 (Quality Education) [1, 2]. Under the Merdeka Curriculum, teachers must design modules that are learner-centred and competency-based. Yet many pre-service teachers struggle due to limited pedagogical design skills and digital literacy [3-5]. Technology offers a solution to these challenges. As shown in Fig. 1, web-based systems can generate instructional content automatically based on input competencies [21]. This automation, often driven by artificial intelligence, uses Natural Language Generation (NLG) and template-based structuring to streamline module creation [4, 22, 23]. Such innovations reflect the application of instructional design science and are aligned with SDG 9 (Industry, Innovation, and Infrastructure), which encourages digital solutions in education. Tools based on AI-TPACK frameworks integrate pedagogy, content, and technology, enabling teachers to focus on meaningful instructional decisions rather than formatting [22, 24]. However, platforms like PMM mostly offer static resources, requiring manual adaptation by users [9-13]. This study fills a key gap by developing a dynamic, AI-supported platform that empowers pre-service teachers with structured, intelligent assistance, bridging technology and pedagogy to support both educational quality and innovation.

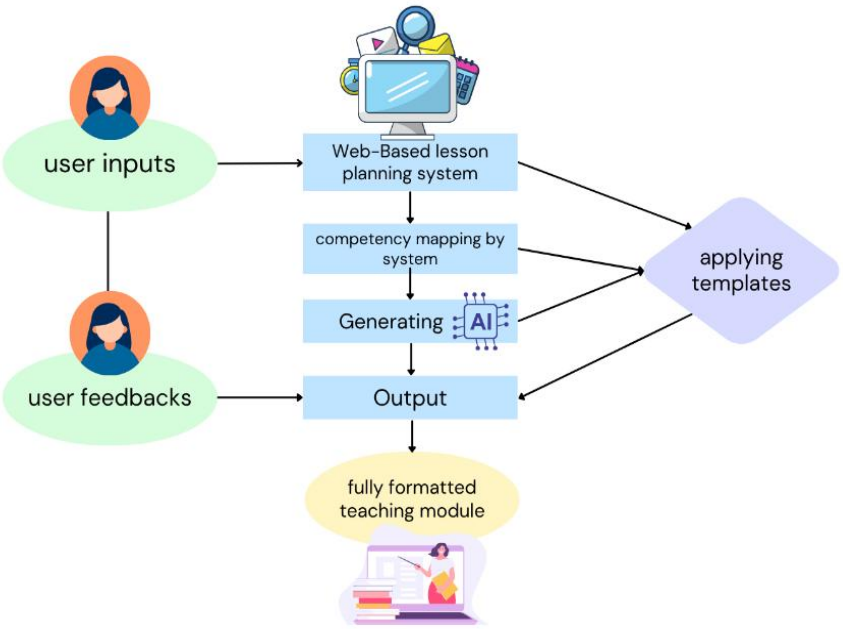

Fig. 1. Web-based generating model.

3. Method

This study used a research and development (R&D) approach to develop Platform for pedagogical planning and AI-Assisted content kit (PPPACK), an AI-assisted web-based tool for creating teaching modules. Detailed information for this method is explained elsewhere [25]. This method covered five stages: problem analysis, data collection, product design, validation, and revision [26]. Data were obtained through observation, interviews, and expert validation involving media, content, and language aspects. Descriptive analysis with Likert scales and percentage calculations was used to assess platform feasibility. The development process is outlined in Fig. 2, showing each iterative stage from design to expert-informed improvement.

4. Result and Discussion

Figure 2 shows the structured development process of PPPACK based on a modified Borg and Gall model. It begins with identifying instructional needs through observation and interviews, followed by systematic stages: data collection, product design, validation, and revision [26]. This process reflects a scientific approach to instructional development, combining educational theory with practical design procedures. The stepwise refinement also demonstrates the application of instructional design science, emphasizing iterative improvement based on empirical data.

Figure 3 shows the user interface of PPPACK, which includes essential functions such as My Courses, Assignments, and Timetable, designed to assist pre-service teachers in planning instruction. The AI-assisted module generator is embedded within "My Courses," where users input learning goals and receive structured lesson plans aligned with the Merdeka Curriculum [1, 4]. The inclusion

of a customizable Settings menu enhances digital flexibility, reflecting user-centred design principles in educational technology [5]. These features align with SDG 9 by integrating technological innovation in instructional systems and support SDG 4 by equipping educators with tools that enhance teaching quality.

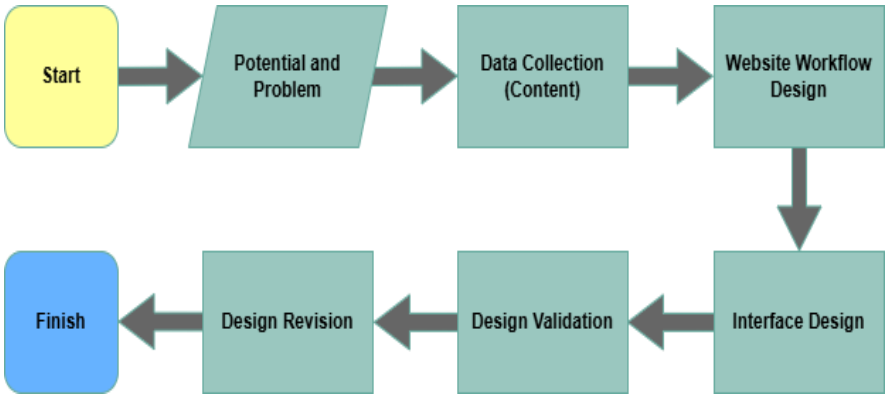

Fig. 2. Prototype of PPPACK development's flowchart.

The results of expert validation assessing the platform's feasibility across media, content, and language are in the following. Media experts rated it at 95.65% for its clarity and interactivity, language experts at 93.75% for linguistic consistency, and content experts at 90.62% for curriculum alignment—yielding an average feasibility score of 93.34%. These results confirm the scientific validity of PPPACK as an instructional tool grounded in educational standards [9, 13]. Validation also ensures that the platform is not only functionally robust but pedagogically sound, strengthening its role in enhancing instructional planning in teacher education.

Figure 4(a) shows how the AI-assisted workflow allows users to generate complete lesson modules from basic topic input. The system, supported by natural language generation (NLG) and template automation, provides subject identity, objectives, learning steps, and assessments in a structured format [22, 23]. This technological process reduces the cognitive load in instructional planning and increases efficiency by more than half compared to manual methods [27]. By embedding AI in pedagogical planning, PPPACK reflects the advancement of instructional design through automation—an essential contribution to digital education infrastructure and scientific innovation.

Figure 4(b) shows the alignment of PPPACK with Sustainable Development Goals, particularly SDG 4 (Quality Education) and SDG 9 (Industry, Innovation, and Infrastructure). The platform improves teacher competence by delivering accessible, AI-driven tools for planning, thus promoting equity in learning preparation [2, 10]. Simultaneously, it fosters the digital transformation of education systems through responsible innovation and infrastructure development [12]. This dual contribution makes PPPACK a model of how science and technology can directly support global education targets. This adds new information regarding SDGs, as reported elsewhere [28-29].

Fig. 3. PPPACK interface display: (a) Sign in web, (b) Profile, (c) Home, (d) My courses, (e) Assignments, (f) Timetable, (g) Forum, and (h) Settings.

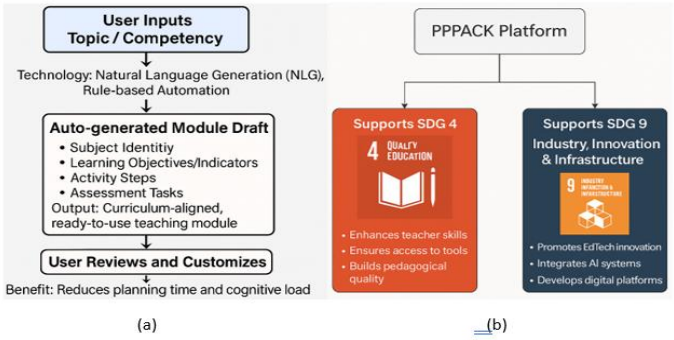

Fig. 4. (a) AI-assisted module generation workflow and (b) Alignment of PPPACK with sustainable development goals.

5. Conclusion

The development of PPPACK, an AI-assisted lesson planning platform, offers a practical and innovative solution for pre-service elementary teachers. By integrating instructional design science with intelligent automation, the platform enhances efficiency, autonomy, and pedagogical competence. Validation results confirmed its high feasibility in terms of usability, content relevance, and language clarity. PPPACK supports SDG 4 by improving access to quality teaching tools and fosters SDG 9 through its application of web-based AI technology. Future research should explore its implementation in microteaching settings to evaluate impact on instructional performance and teacher readiness in real-world classrooms.

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