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CANVAS-BASED E-MODULE FOR ENHANCING ALGEBRAIC NUMERACY IN JUNIOR HIGH SCHOOL STUDENTS

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Abstract

This study developed an interactive e-module using Canvas learning management system (LMS) to enhance algebraic numeracy skills among junior high school students, addressing the limited use of contextual and interactive digital resources in mathematics education. The research improved students' ability to apply algebraic reasoning in real-life situations. A design-based research (DBR) approach was implemented, involving needs analysis, design, expert validation, and limited trials. The module incorporated multimedia content, simulations, and collaborative tasks to foster student engagement and problem-solving. Validation results showed high ratings in content (92.7%), language (88.4%), visual design (85.9%), and contextual relevance (90.5%). Trial findings revealed improved participation, problem-solving, and application of algebra to daily life because the module connected abstract algebraic concepts with everyday experiences. This study provides a scalable model for enhancing mathematics instruction through interactive, real-world digital learning.

Keywords: Algebra, Canvas instructure, E-module, Junior high school students, Numeracy.

1. Introduction

The growing need for innovative and interactive digital learning resources in junior high school mathematics has highlighted the importance of developing effective tools to enhance students' numeracy skills [1, 2]. Traditional methods often fail to connect algebraic concepts with real-life contexts, limiting students' ability to apply mathematical reasoning in daily situations [3]. Algebraic numeracy, which involves interpreting, representing, and solving problems through algebraic reasoning, is essential for developing logical thinking and problem-solving skills [3-5].

Canvas learning management system (LMS) offers a flexible, interactive environment for creating structured, media-rich e-modules suitable for junior high school students [6]. Its features support active learning, enabling the integration of multimedia, discussions, and assessments to promote student engagement and independent learning [1].

Table 1 explains previous studies on the development of technology-enhanced e-modules in mathematics education, grouped into three themes: (i) contextual and cultural integration, (ii) multimedia and interactivity, and (iii) LMS-based design. These studies demonstrate the effectiveness of ethnomathematics, project-based learning, and realistic mathematics education in improving skills like logical thinking, mathematical communication, and literacy [7-13].

Table 1. Previous studies on e-modules in mathematics education.

No.	Research Title	Ref.
1	E-module based on ethnomathematics comics with the ICARE model to improve students' mathematical representation skills.	[7]
2	Development of integrated e-module with Liveworksheets based on PjBL with ethnomathematics nuances of typical Indonesian foods to enhance mathematical literacy.	[8]
3	The impact of project-based learning with e-modules on mathematical communication skills.	[9]
4	Development of an ethnomathematics-based e-module to improve students' metacognitive ability in 3D geometry topic.	[10]
5	Development of e-modules using the context of the Muara Enim traditional house on polyhedron materials.	[11]
6	Developing interactive e-module based on realistic mathematics education approach and mathematical literacy ability.	[12]
7	E-module interactive of minimum competency assessment: Development and understanding for mathematics teachers.	[13]

This study aims to develop an interactive e-module using Canvas LMS to enhance algebraic numeracy skills among junior high school students. The module was designed through a design-based research (DBR) approach, involving needs analysis, design, expert validation, and limited trials [14, 15]. The novelties of this research are: (i) integrating real-life numeracy contexts into algebra learning; (ii) utilizing Canvas LMS as an interactive instructional platform; (iii) designing activities that foster algebraic reasoning in practical scenarios; (iv) applying a design-based research (DBR) framework for systematic development; and (v) conducting expert validation and empirical trials with

teachers and students to ensure effectiveness. Specifically, this study also adds new information regarding the development of teaching and learning process for junior high school students, as reported elsewhere [16-21]. This strategy bridges abstract concepts with everyday experiences, promoting engagement, problem-solving, and contextual understanding.

2. Literature Review

Canvas Instructure is a widely used learning management system (LMS) that supports digital learning in educational institutions [1]. It provides structured tools for content delivery, including assignments, quizzes, discussion forums, multimedia integration, and automated grading systems [22, 23]. These features enhance communication and interaction between teachers and students, fostering flexible and engaging learning environments.

Figure 1 shows the core components of an LMS: content authoring, certification management, learning management, course library, extended enterprise, testing, and virtual classroom and training. These integrated functions enable LMS platforms like Canvas to effectively support modern, technology-enhanced learning environments.

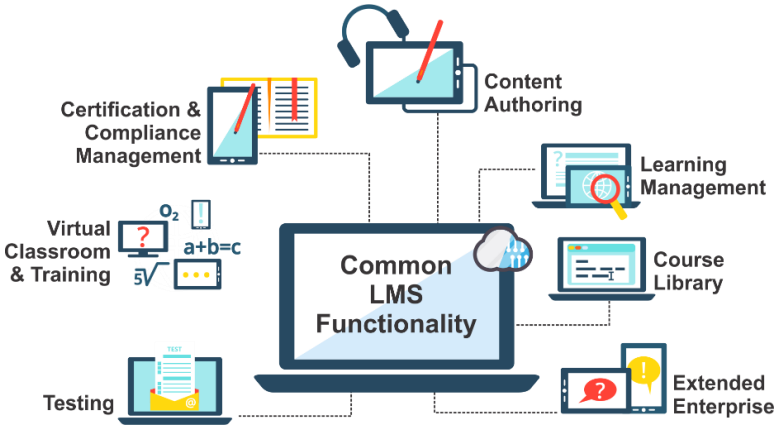

Fig. 1. Learning management system (LMS) model.

3. Method

This study adopted a DBR framework consisting of four phases: analysis, design, development, and reflection [14, 15]. Detailed information regarding this method is reported elsewhere [24]. The analysis phase identified the needs of junior high school students and teachers in enhancing algebraic numeracy skills. The e-module was designed by integrating real-life contexts into algebra topics and developed on Canvas LMS to incorporate multimedia and interactive elements. Using structured instruments, four expert validators assessed content quality, visual design, interactivity, and contextual relevance. A limited trial involving teachers and students evaluated the module's effectiveness through surveys and numeracy tests, focusing on engagement, problem-solving, and real-world application of algebraic concepts.

4. Results and Discussion

Figure 2 explains the interaction framework that structured the e-module design, integrating cognitive, social, and teaching presence. These dimensions supported interactive learning activities, such as simulations, collaborative tasks, and instructor feedback, ensuring student engagement and algebraic numeracy development [25-30]. The framework was shaped by a needs analysis, which identified teachers' demand for contextual materials and students' preference for interactive, relatable content [31, 32].

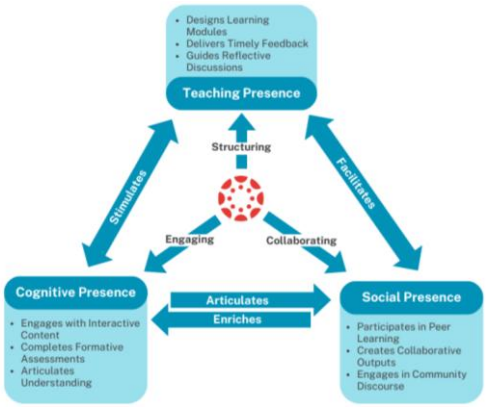

Fig. 2. Interaction framework in Canvas-based e-module for enhancing algebraic numeracy skills.

Figure 3 explains the learning sequence applied in the e-module, starting from pre-tests, progressing through multimedia content, simulations, and discussions, and ending with contextual evaluations. This sequence embedded algebra concepts into real-life scenarios such as budgeting and measurements, fostering problem-solving and conceptual understanding [33, 34].

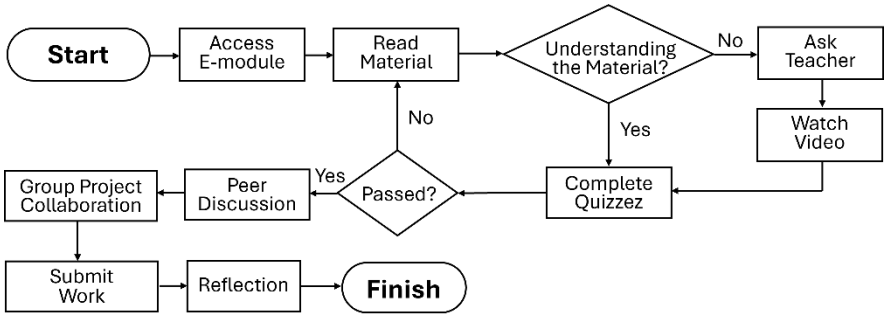

Fig. 3. Flowchart of interactive learning process.

Figure 4 explains the final e-module design: Fig. 4(a) for topic overview page, Fig. 4(b) for contextual problem-solving activities, Fig. 4(c) for collaborative algebra tasks, and Fig. 4(d) for instructional videos. Validation from four experts (i.e., mathematics educators and digital learning specialists) rated the module highly. We got 92.7% for content, 88.4% for language, 85.9% for visual design,

and 90.5% for contextual relevance, which is good compared to the literature [35, 36]. Feedback led to refinements in terminology standardization and problem contextualization.

Trial results demonstrated the module's effectiveness in improving student engagement and numeracy skills. Students actively participated in discussions, showed increased problem-solving abilities, and connected algebraic concepts to daily life. Teachers reported enhanced interactivity and lesson delivery. These outcomes support findings that contextualized, interactive modules improve both student learning and instructional quality [37-40]. This study adds new information regarding numeracy skills in the teaching and learning process, as reported elsewhere [41-44].

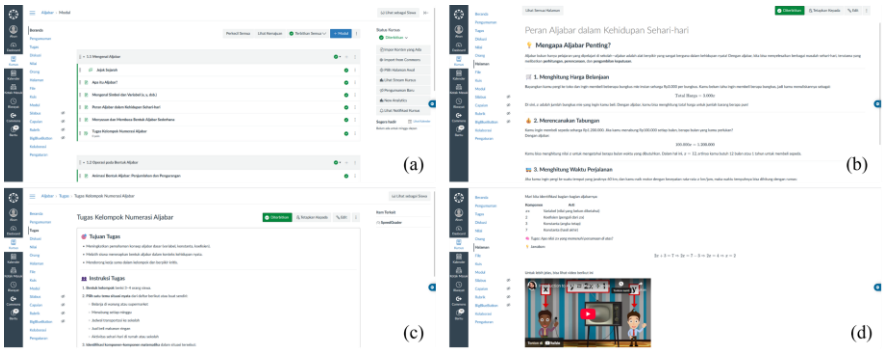

Fig. 4. Teaching material, student activity, evaluation of e-module: (a) Topic overview page; (b) Learning material page; (c) Collaborative algebra task; (d) Instructional video page.

5. Conclusion

The Canvas-based e-module effectively improved junior high school students' algebraic numeracy skills by integrating real-life contexts into algebra learning. Developed through a DBR approach, it combined multimedia, simulations, and collaborative tasks. Expert validation and trial results confirmed its quality and impact, enhancing student engagement, problem-solving, and the application of algebra in daily life. This study demonstrates that interactive, contextual digital tools can significantly strengthen numeracy skills and support innovative mathematics instruction.

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