



Development of Interactive E-Module for AutoCAD Learning Based on Case Method in the Multi-storey Building Construction Modeling Course

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ABSTRACT

The implementation of the case method in higher education learning activities is one of the implementations of the regulations established by the Ministry of Education and Culture, which falls under Key Performance Indicator (IKU) Number 7. The case method, when applied in higher education learning activities, can be combined with e-learning modules to achieve greater optimization and to enhance students' higher-level thinking skills. One of the civil engineering courses at the Construction Engineering Education Program in UNNES that can implement an e-module based on case method is the Multi-storey Building Construction Modeling Course, especially in AutoCAD learning materials. The research employs the R&D method using the ADDIE model for e-module development. The aim of this research is to develop an interactive e-module based on case method in the Multi-Story Building Construction Modeling course, especially in AutoCAD learning materials. This initiative seeks to enhance the effectiveness and enjoyment of course activities for students. The result of this research is an e-module that falls into the good quality category, with average ratings from media experts 1 and 2 being 83.00 and 84.17, from content experts 1 and 2 being 83.68 and 86.13, and an average rating from student responses during limited classroom trials being 82.24. The conclusion drawn from this research is that the AutoCAD E-Module based on case method can be implemented in the teaching process of the Multi-Story Building Construction Modeling course.

Keywords: *E-module, AutoCAD, Case method, Learning*

1. INTRODUCTION

The current growth in the field of education is in line with rapid advancements in science and technology, especially in the context of the Industrial Revolution 4.0. Education in this era emphasizes learning efforts aimed at developing critical thinking skills, creativity, digital literacy, information literacy, media literacy, and expertise in information and communication technology [1], [2].

In higher education, the learning process is focused on achieving course competencies as outlined in the Indonesian National Qualifications Framework (KKNI). One of these competencies involves developing critical thinking and problem-solving skills [3], [4]. Mastery of information and communication technology, along with critical thinking and problem-solving abilities, becomes a key factor for university graduates to compete in the workforce.

To reach these objectives, one effective strategy is to create interactive e-modules. The primary aim of these e-modules is to improve the efficiency and efficacy of classroom learning. This approach is intended to help students thoroughly understand the material, promoting advancements in cognitive, affective, and psychomotor domains. Consequently, students are expected to better develop critical thinking, creativity, and problem-solving skills [5], [6]. One idea for e-modules is to create interactive versions based on the case method. The case method is a participatory learning approach where students are presented with a problem to solve, providing them with a practical learning experience. The material in these e-modules aims to enhance students' critical thinking skills as they work through the problem-solving process [7]–[9]. Moreover, the application of the case method in learning activities can make the learning process more effective [10]–[13]. The combination of applying interactive e-modules with the case method can

provide significant benefits for students in their classroom learning process, including increased motivation to learn and enhanced higher-order thinking skills (HOTS) [14], [15].

One of the courses in the Civil Engineering field within the Construction Engineering Education Program at UNNES that can integrate interactive e-modules based on the case method is the Multi-Story Building Construction Modeling course. This course generally covers material on multi-story building construction and methods for creating construction drawing documents using computer software, specifically AutoCAD. The current classroom learning situation still relies on conventional modules derived from various appropriate reference books, while teaching processes are predominantly based on lectures and practice. Additionally, based on the initial conditions of students' proficiency with the AutoCAD program, out of 71 students who responded to the questionnaire, only 3 students (4.23%) felt they had mastered AutoCAD highly proficient, and 24 students (33.80%) felt they had moderately proficient of AutoCAD. The remaining students felt they did not master AutoCAD or had never used it at all. The complete results can be seen in Figure 1 below.

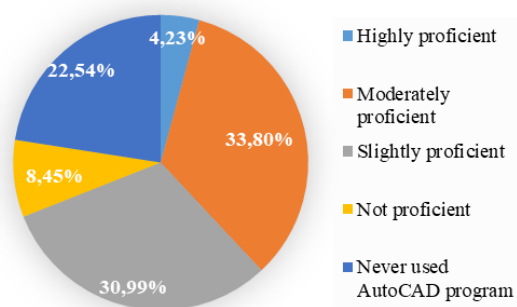


Figure 1 The initial condition of students' proficiency with the AutoCAD program.

Given these conditions, it is essential to conduct research on the development of innovative interactive e-modules using the case method, with a specific focus on AutoCAD material. Interactive e-modules based on the case method can offer students a more practical understanding of using AutoCAD and applying it to create construction drawing documents. Mastery of AutoCAD is vital for students, as it is a required skill for competing in the workforce, whether in the construction services industry or vocational education [16]–[18]. Proficiency in AutoCAD also assists students in completing tasks in other courses related to technical drawing.

The research problem to be investigated in this study is how to develop an interactive e-module for AutoCAD learning based on the case method in the Multi-Story

Building Construction Modeling course, and how experts in media, subject matter experts, and students respond to the developed interactive e-module.

The implementation of the case method in higher education learning activities is one of the applications mandated by the Ministry of Education and Culture. According to Ministerial Decree Number 754/P/2020, stated under Key Performance Indicator Number 7, which specifies that "Learning in the percentage of undergraduate (S1) classes and diploma (D4/D3/D2) courses that use case method learning or team-based project learning as part of the evaluation weight with a minimum assessment weight of 50%." The case method, when integrated into learning activities with e-learning modules, can optimize learning outcomes and enhance students' higher-order thinking skills [19]. Engaging students in learning activities with the case method provides opportunities for them to explore their potential, express themselves, innovate, and find solutions to real-world situations. Consequently, students can be focused on achieving outstanding achievements in developing their potentials [20]. The application of interactive e-learning modules based on the case method in classroom learning processes can have positive impacts on learners. These include improving students' learning outcomes and developing their critical and creative thinking abilities [21]–[23].

Based on the previous research findings above, it is evident that the implementation of the case method in classroom learning processes is highly beneficial. However, research specifically on the development of interactive AutoCAD e-modules based on the case method, particularly for the Multi-Story Building Construction Modeling course, has not been conducted. Therefore, research on the development of interactive e-learning modules for AutoCAD based on the case method in the context of Multi-Story Building Construction Modeling is warranted and worthy of pursuit.

2. METHODOLOGY

The method used for developing the e-module in this study is the Research and Development (R&D) approach, employing the ADDIE model. The ADDIE model is a structured development process that involves five stages: Analysis, Design, Development, Implementation, and Evaluation. This method ensures a comprehensive progression from the initial analysis through to the final evaluation of the e-module, covering design, content creation, and implementation [24].

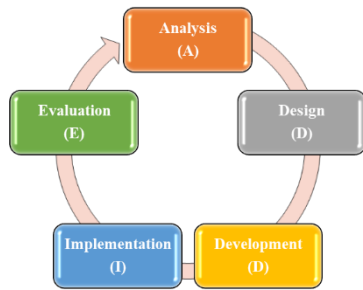


Figure 2 The ADDIE development model.

Here are the stages of conducting research using the ADDIE development model, as illustrated in Figure 2 above:

2.1. Analysis Stage

In this stage, the researcher analyzes the e-module needs as perceived by students who have previously taken the Multi-Story Building Construction Modeling course, particularly focusing on AutoCAD, within the Construction Engineering Education Program batch of 2023. This is done through a survey using a Google Form questionnaire distributed to the students. Additionally, the researcher analyzes the course materials of Multi-Story Building Construction Modeling, especially those related to AutoCAD, and evaluates their alignment with current technological advancements.

2.2. Design Stage

In this stage, the researcher develops the conceptual design of the e-module using insights gathered from the analysis stage. Furthermore, the researcher identifies which topics necessitate video illustrations and create a strategy for integrating the case method into classroom learning activities.

2.3. Development Stage

In this stage, the researcher undertakes the following activities:

- a) Developing the implementation plan for the case method in classroom learning activities.
- b) Developing the e-module for the Multi-Story Building Construction Modeling course with AutoCAD learning material according to the previously formulated e-module design concept.
- c) Incorporating the case method implementation plan into the e-module.
- d) Adding supporting video illustrations to the material.
- e) Finalizing the e-module using the Sigil program and converting it into EPUB format.

2.4. Implementation Stage

In this stage, the researcher conducts a preliminary trial of the e-module implementation involving two subject matter experts and two media experts from the Construction Engineering Education Program at UNNES, each proficient in their respective fields. Additionally, a trial is conducted with students to assess their feedback on the practicality of the developed e-module. The quality score of the e-module is determined using the following formula:

$$P = (\Sigma S/N) \times 100$$

With:

- P = e-module quality score
- ΣS = total score obtained
- N = maximum possible score

Here are the quality score categories for the e-module:

| | |
|-----------------|----------------|
| Less than 70.01 | : Not Suitable |
| 70.01 – 80 | : Adequate |
| 80.01 – 90 | : Good |
| 90.01 – 100 | : Very Good |

2.5. Evaluation Stage

In this stage, the researcher evaluates and refines the e-module based on feedback from media experts, subject matter experts, and student responses. This iterative process aims to ensure that the e-module meets the standards required for effective classroom learning.

3. RESULTS AND DISCUSSION

The development of the AutoCAD e-module for the Multi-Story Building Construction Modeling course adheres to the five development stages of the ADDIE model: analysis, design, development, implementation, and evaluation.

In the analysis stage, the researcher conducts an initial analysis to ascertain the type of e-module required by students. This involves distributing an initial survey to 71 students enrolled in the Multi-Story Building Construction Modeling course. The results of this survey, detailing the students' e-module requirements, are depicted in Figure 3 below.

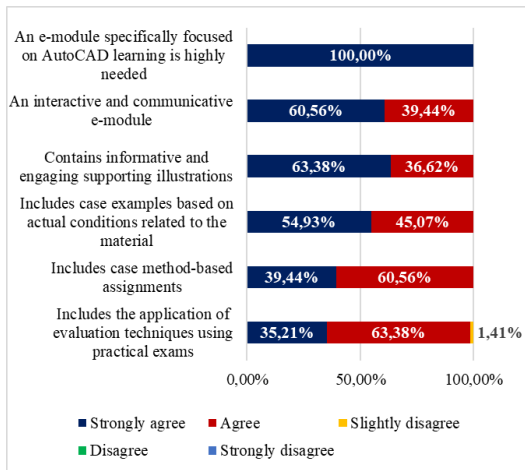


Figure 3 The e-module requirements based on the initial student survey results.

Based on Figure 3 above, it can be concluded that students unanimously (100%) agree on the need for an interactive e-module for the Multi-Story Building Construction Modeling course, specifically focusing on AutoCAD material. Regarding the type of e-module required, Figure 3 shows that all respondents strongly agree and agree to varying degrees that the e-module should be interactive and communicative, with engaging illustrations. It should also incorporate the case method both in the material and assignments, and use practical exams as an evaluation method.

In the design stage, the researcher formulated the e-module design concept based on findings from the analysis stage. Additionally, the researcher identified materials requiring video illustrations and developed a plan for integrating case study methods into classroom activities. This stage produced a content blueprint for the interactive AutoCAD e-module, depicted in Figure 4 below.

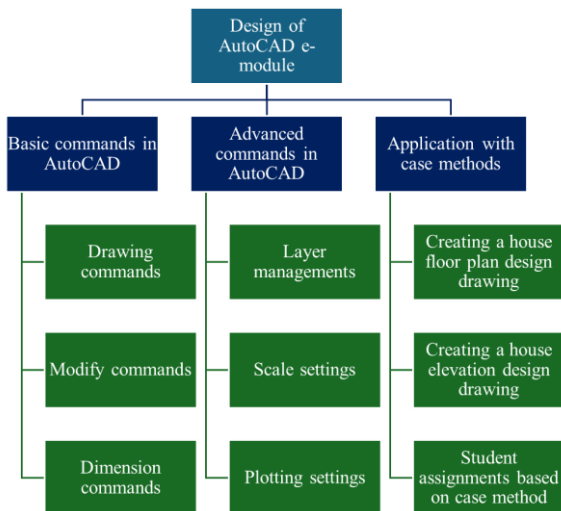


Figure 4 Content plan for the interactive AutoCAD e-module.

At the development stage, At the development stage, the researcher created the e-module based on the design prepared in the design phase. The e-module was created using Microsoft Word and then converted to EPUB format using the Sigil program. The following is an example of the developed e-module interface.

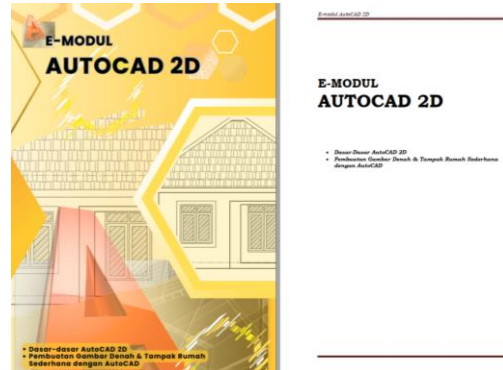
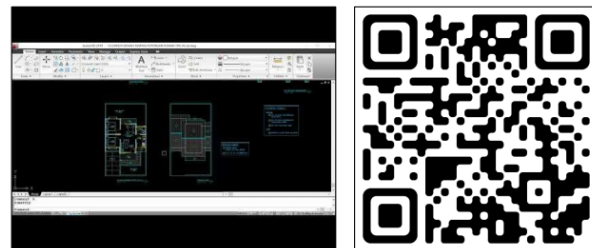
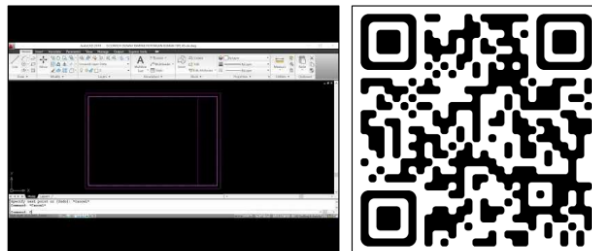


Figure 5 Initial page layout of the interactive AutoCAD e-module



Pengaturan dan Pembuatan Tipe Dimensi
(Sumber : <https://www.youtube.com/@listiyonobudi>)



Pengaturan Skala, Kop dan Pencetakan Gambar
(Sumber : <https://www.youtube.com/@listiyonobudi>)

Figure 6 Example of video material link layout in the interactive AutoCAD e-module.

The next stage in the development process of the interactive AutoCAD e-module is the implementation stage. Here, the researcher evaluates the material and media aspects of the e-module with experts from the Construction Engineering Education Program at UNNES who possess expertise in their respective fields. Following this, a limited trial of the e-module is conducted in a classroom setting to assess students' responses regarding its practicality in supporting their learning activities. This trial involves 63 students from the 2023 cohort enrolled in the Multi-Story Building Construction Modeling course.

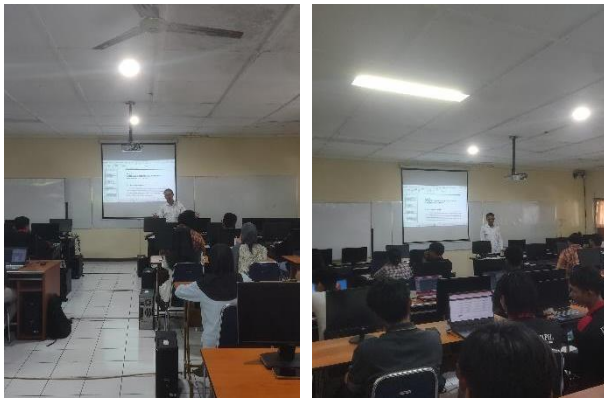


Figure 7 Limited trial of the interactive AutoCAD e-module.

The final stage in the development of the interactive AutoCAD e-module is the evaluation stage. Here, the researcher refines the e-module based on feedback gathered from media experts, content specialists, and student responses. This evaluation process is aimed at improving the quality and effectiveness of the e-module, ensuring its suitability for practical use in classroom learning environments.

Here are the findings of the evaluation concerning the media elements of the e-module from media experts, the content aspects from content experts, and the practicality aspects from students during the limited classroom trial.

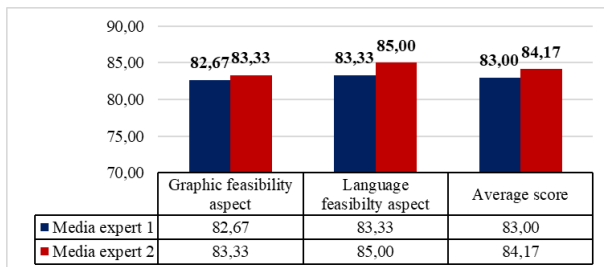


Figure 8 Assessment results for the media aspects of the AutoCAD e-module.

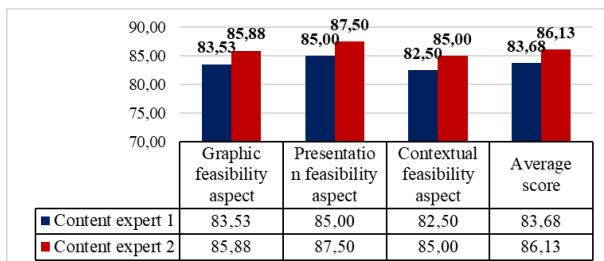


Figure 9 Assessment results for the content aspects of the interactive AutoCAD e-module.

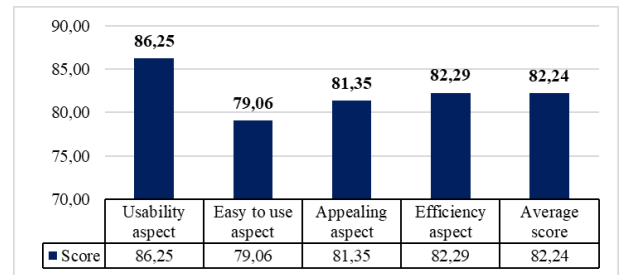


Figure 10 Assessment results for the practicality aspects of the interactive AutoCAD e-module

According to Figures 8 to 10 above, it is evident that the interactive AutoCAD e-module is classified as "good" across all three evaluated aspects. The average scores for these assessments range from 80.01 to 90, placing them within the "good" category.

4. CONCLUSION

Based on the research conducted on the development of the interactive AutoCAD e-module in the Multi-Story Building Construction Modeling course, the conclusion is that the creation of this e-module significantly enhances the classroom learning experience. The quality assessment places the e-module in the "good" category across all evaluated aspects: media, content, and practicality.

Drawing from the research analysis and conclusions, recommendations for future research include investigating the effects of implementing the interactive AutoCAD e-module on students' learning engagement, educational outcomes, and other cognitive dimensions..

AUTHORS' CONTRIBUTIONS

Listiyono Budi carried out the analysis design, e-module design, participated in data analysis and wrote the manuscript. Eko Nugroho Julianto participated in the analysis design and data analysis. Retno Mayasari participated in the e-module design and helped to draft the manuscript. Istianah participated in e-module design and helped to draft the manuscript. Cholil Said Agil Husain participated in data analysis and helped to draft the manuscript. Fawwaz Diva Ar-Rafi participated in data collection and e-module design. All authors read and approved the final manuscript.

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