# Designing the Computer Assisted Instruction (CAI) Integrated Case Method-Flipped Classroom on Engineering Education

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**Abstract.** Case method is one of instructional model that recommended by Educational Ministry to be implemented on engineering education. Covid-19 pandemic that has been happened, making all learning activities has to implement blended learning. Students are directed to learn individually at home before going face to face learning, the method is called flipped classroom supported by Computer Assisted Instruction (CAI). Combination of both case method and flipped classroom supported by CAI have to be implemented, due to support blended learning optimally. This research aims at designing the CAI integrated case method-flipped classroom as an offered solution to implement blended learning on engineering education. Design of CAI integrated case method-flipped classroom uses explanatory sequential method design. CAI integrated case method-flipped classroom designed is tested to 35 students to describe the effectiveness of CAI integrated case method-flipped classroom to be implemented. The results of research showed that CAI integrated case method-flipped classroom was effective to be implemented widely. It can be concluded that CAI integrated case method-flipped classroom can be alternative solutions for blended learning on engineering education. The novelty of this research is emerging of CAI and case method that implemented by flipped, which is the previous research has not been yet implement flipped using CAI-case method.

**Keywords:** Computer Assisted Instruction (CAI) · case method · flipped classroom · engineering education

## 1 Introduction

After the COVID-19 pandemic, many changes occurred in education and learning systems, such as online and blended learning [1]. One of the solutions to implementing a learning system like this is the use of computer-based media, also known as computer-assisted instruction (CAI) [2].

Utilizing educational media can help students grasp concepts and be able to apply them in the form of practical skills, enabling them to meet learning objectives [3]. The development of learning media is very important in the world of education, if for no other reason than to overcome the shortcomings and limitations of the media that exist today [4]. Since learning media is one of the most crucial and fundamental elements supporting the learning process, it is required to boost its utilization and management in order to reach the desired outcomes [5, 6]. Models or props, flowcharts, tables, or computer-based media are all examples of learning media. The use of computers as learning tools is crucial to the learning process [7].

According to Hartanto et al. [8], One benefit of employing computer learning resources is that they help motivate pupils to complete exercises because of the availability of (1) graphic animation, (2) colours, and (3) music. Computers and even notebooks or laptops are no longer a luxury item, so many people already have computers. Therefore, computer-mediated learning can facilitate students' learning independently. Students can study using computers both at school and at home.

The case method, as the method recommended by the current Ministry of Education, if implemented using CAI, will produce innovative learning media. This can support online and blended learning because of its flipped application. The COVID-19 pandemic that occurred when learning could not be carried out 100% face-to-face. Based on that, there is a need for innovation to enable the implementation of learning [9].

The drawback of the learning that was implemented during the COVID-19 pandemic with the application of the case method-folded curriculum was the utilization of media that could support learning activities. Almost all aspects of human work, including the implementation of education, are helped by computer technology. In particular, the use of CAI in learning can improve learning outcomes [10] and student skills [11].

Based on previous research that applied the flipped and case methods without supporting CAI [12–16], the novelty of the research is the development of CAI, which integrates the case method, which is implemented in a flipped classroom. As a result, the goal of this study is to create a computer-assisted instruction (CAI) integrated case method-flipped classroom in order to make learning more effective and optimal.

## 2    Method

This study will create computer-assisted instruction (CAI) learning media that will be integrated with the case-method flipped classroom. The procedure for developing an integrated computer-assisted instruction (CAI) case for a method-flipped classroom uses a 4-D (four-D). The 4D consists of 4 stages, namely: (1) definition (determination of material); (2) design (design); (3) development; and (4) dissemination [17].

The research instrument used to collect data in this study is a questionnaire. 32 students from the Department of Mechanical Engineering who were enrolled in the Vocational Pedagogy course served as the research participants in this study. To characterize the acquired data, a descriptive data analysis technique was utilized, and Aiken's V coefficient is used to analyse validation data.

# 3  Results and Discussions

## 3.1  Define

In the student analysis, an analysis of the conditions and characteristics of the students was carried out, and the test subjects in using the game-based learning media developed were students of the Department of Mechanical Engineering who were in the age range of 18 to 20 years. Students of that age tend to prefer contrasting colours that aren't too flashy, as well as interesting animated characters or pictures. In the analysis of concepts and tasks, an analysis is carried out on the concepts of indicators and learning objectives that will be used in the development of an integrated computer-assisted instruction (CAI) or case method-flipped classroom.

## 3.2  Design

At this design stage, there are several activities, namely the preparation of the test, the selection of media, the selection of the right format, and the initial design (prototype) of the integrated case method-flipped classroom Computer Assisted Instruction (CAI). At the stage of preparing this test, the preparation of the test will be used as an evaluation tool to determine students' higher order thinking skills. The tests arranged at this stage are the pre-test and post-test, which function to see students' higher order thinking skills.

After the test preparation stage, the media selection stage will be carried out to be used in the development of an integrated computer-assisted instruction (CAI) case method-flipped classroom. The media used in developing the integrated case method-flipped classroom computer-assisted instruction (CAI) is Adobe Flash. Next is the format selection stage in the development of a case method-flipped integrated computer-assisted instruction (CAI), the chosen format is writing, with learning objectives, material descriptions, and evaluation in the form of case studies presented first.

## 3.3  Develop

This development stage aims to develop and obtain a valid case method-flipped classroom integration with computer-assisted instruction (CAI). At this development stage, two activities were carried out, namely the development stage of the integrated case method-flipped classroom Computer Assisted Instruction (CAI) and the validation stage for the integrated case method-flipped classroom Computer Assisted Instruction (CAI), where in the validation activity there were validation activities assessed by several experts.

At this stage, a display design framework for the integrated Computer Assisted Instruction (CAI) integrated case method-flipped classroom was prepared, which included the home menu, which is the main menu, the material menu, and the evaluation menu, which contains cases for solving problems to test students' higher-order thinking skills (HOTs). The results of the display design of the integrated Computer Assisted Instruction (CAI) case method-flipped classroom on the case page can be seen in Fig. 1.

On this case page, the integrated Computer Assisted Instruction (CAI) case method-flipped classroom is made interactive by providing feedback to students when they try
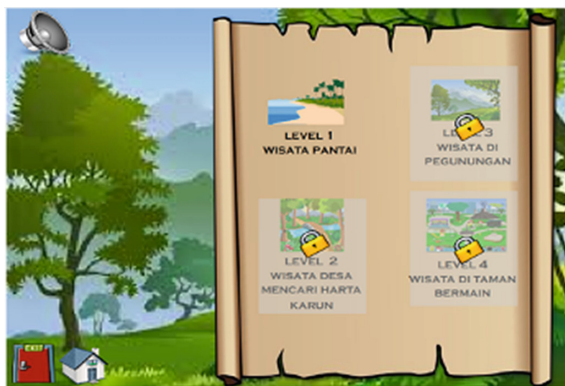
**Fig. 1.** The Cases Page



**Fig. 2.** The Score Page

to solve cases on the page. If the answer chosen by the student is wrong, the computer will display an explanation for the correct answer.

After students solve cases at one level, the media will raise several questions that must be answered by students, and these answers will display the scores obtained by students in answering these questions. The score page display can be seen in Fig. 2.

A validity test should be performed on the integrated case method-flipped classroom before it is used in learning activities. The integrated Computer Assisted Instruction (CAI) case method-flipped classroom conducted the validation test phase to ascertain its viability based on the evaluation of content experts and media experts. To gain accurate status from specialists, validation activities are being carried out in this study. The validation process will continue until a valid Computer Assisted Instruction (CAI) integrated case method-flipped classroom is obtained if the integrated Computer Assisted Instruction (CAI) case method-flipped classroom is not valid. If the validator has determined that the media is genuine and there have been no adjustments to the integrated Computer Assisted Instruction (CAI) case method-flipped classroom, then the latter is deemed to be valid.

The final product design is validated by media validation. This media validation contains three components, namely characteristics of content quality, interaction quality, and display quality. It was carried out by two media specialists. In the early stages of validation, the integrated Computer Assisted Instruction (CAI) case method-flipped classroom can already be used, but there are still revisions based on the suggestions given by the validator. Data validation results of the integrated Computer Assisted Instruction (CAI) case method-flipped classroom can be seen in Table 1.

On the basis of Table 1, it displays the validation's outcomes of the integrated case method-flipped classroom Computer Assisted Instruction (CAI) material obtained by Aiken's V With a coefficient for content quality of 0.93, interactive quality of 0.87, and display quality of 0.91, this is valid for all media categories.

Additionally, the validation performed by material experts is examined in light of three assessment criteria: didactic criteria, building criteria, and technical criteria. In carrying out its validity, material experts reviewed the material contained in this integrated computer-assisted instruction (CAI) case method-flipped classroom. Table 2 displays the outcomes of the material validation.

Table 2 shows that the integrated Computer Assisted Instruction (CAI) case method-flipped classroom has an Aiken's V coefficient for didactic requirements of 0.86, for constructive requirements of 0.83, and for technical requirements of 0.75, so all are included in the valid category. The findings of this evaluation are similarly consistent with those of earlier work by Rizki and Sukardi [18], who claimed that with a proportion of 88.00%, the media he created fell within the category of being valid; Huda et al. [19] also demonstrated that the developed learning media were included in the legitimate category with a percentage of 80.95%, and Folk and Rizki [20] with a validity percentage of 85.36%, so in terms of the truth or accuracy of the media, The learning process can be implemented with the learning medium.

**Table 1.** Media Validation Results

| No. | Validation Aspect | Aiken's V Coefficient | Category |
|-----|-------------------|----------------------|----------|
| 1. | Quality of content aspect | 0,93 | Valid |
| 2. | Quality of interaction aspect | 0,87 | |
| 3. | Quality of interface aspect | 0,91 | |

**Table 2.** Material Validation Results

| No. | Validation Aspect | Aiken's V Coefficient | Category |
|-----|-------------------|----------------------|----------|
| 1. | Didactic | 0,86 | Valid |
| 2. | Constructive | 0,83 | |
| 3. | Technique | 0,75 | |

### 3.4 Disseminate

By integrating the flipped classroom and Computer Assisted Instruction (CAI) case approach into the teaching and learning process, the diffusion step is carried out. A procedure of transmission to experts in related learning in a specific forum can also be used for dissemination. At this point, the deployment was made to the Mechanical Engineering Department in order to assess how the flipped classroom with integrated case method and computer-assisted instruction (CAI) will affect student performance.

## 4 Conclusion

Computer Assisted Instruction (CAI) is an integrated case method-flipped classroom that is produced in the form of case-based learning media. The designed integrated Computer Assisted Instruction (CAI) case method-flipped classroom was deemed acceptable after being approved by specialists, mainly media specialists and subject matter specialists. The evaluation's findings for media validation and the evaluation's findings for material validation are both deemed valid.

This research is limited to the development of an integrated case method-flipped classroom using computer-assisted instruction (CAI). It is hoped that in future studies, they will be able to apply the integrated case method-flipped classroom computer assisted instruction (CAI) to see how it affects student competency.

**Authors' Contributions.**    Rizky Ema Wulansari: Conceptualize, design, interpret data, and draft it into articles.

Siska Miga Dewi dan Rizkayeni Marta: Drafting, analyzing data, and reviewing articles.

Rizki Hardian Sakti dan Primawati: Design, collect data, and review articles.

Chau Trung Tin: Proofreading the articles.

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