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Development of Video Animation-Based Learning Media for Steel Structure Courses

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ABSTRACT

This study was conducted in response to the implementation of online learning in the Steel Structure course. One of the main challenges encountered was the inability of lecturers to directly demonstrate tensile testing procedures to students, as laboratory practicum could not be carried out. Therefore, this study aimed to develop a video animation-based learning media that is feasible for use in the Steel Structure course. This research employed the Research and Development (R&D) method. The subjects involved in this study included expert validators consisting of two subject-matter experts and one media expert. In addition, the participants were students from the Building Engineering Education program, comprising 20 students who attended face-to-face classes and 20 students who participated in online learning. Furthermore, the product was also evaluated by three lecturers responsible for teaching the Steel Structure course. The results of the study showed that the product evaluation by the first subject-matter expert yielded a score of 3.28, categorized as very good, while the second subject-matter expert also gave a score of 3.28 with the same category. The media expert evaluation resulted in a score of 3.65, categorized as very good. The student trial evaluation obtained a score of 3.19, also categorized as very good. Moreover, the evaluation from the course lecturers resulted in a score of 3.49, categorized as very good. Based on these findings, the developed video animation-based learning media is considered feasible and appropriate for use in the teaching and learning process of the Steel Structure course.

INTRODUCTION

The rapid advancement of technology and scientific knowledge has significantly transformed various aspects of human life. This accelerated development demands high-quality human resources capable of adapting to continuous technological progress. During the COVID-19 pandemic, existing technologies experienced even greater acceleration, particularly in the education sector. The outbreak began to spread globally in mid-March 2020, prompting the Government of the Republic of Indonesia to implement various measures to prevent further transmission. One of the primary strategies was the restriction of social and educational activities through the implementation of physical distancing policies, including maintaining at least one meter of distance and avoiding large gatherings.

In the education sector, these restrictions led to a shift from conventional face-to-face learning to online (distance) learning. Online learning was considered the most feasible solution to ensure the continuity of teaching and learning activities during the pandemic. This approach enabled educational processes to continue effectively and efficiently despite the absence of physical interaction. Each educational institution adopted its own policies to support this transition, including providing internet data subsidies for students. One of the higher education institutions implementing this policy is *Universitas Negeri Padang* (UNP).

Universitas Negeri Padang (UNP), as a public university in Indonesia, has implemented an online learning system across its faculties. However, in the Faculty of Engineering, particularly in the Civil Engineering Department, online learning poses significant challenges. While theoretical content

can be delivered relatively effectively, it is considerably more difficult to ensure students' understanding of subjects that involve calculations, design processes, and practical activities, such as the Steel Structure course.

The Steel Structure course provides fundamental knowledge of steel as a construction material, including its properties, design principles, and applications in structural engineering. The course covers topics such as basic structural concepts, steel design regulations based on SNI 2020, material properties of steel, steel sections, tension members, and the design of bolted and welded connections. Most of these topics involve analytical calculations, while some require experimental testing conducted in a workshop environment [1].

Based on an interview conducted with the lecturer of the Steel Structure course on December 10, 2020, several issues were identified, particularly in teaching the topic of steel tension members. The main challenge lies in the inability to demonstrate tensile testing procedures directly to students due to the absence of laboratory practicum during online learning. In practice, tensile testing is essential for determining the mechanical properties of steel through stress–strain curves, and students are expected to understand both the experimental process and the corresponding design calculations. Under normal conditions, this testing is conducted in a workshop under the supervision of lecturers and technicians, with students observing the procedure directly.

Considering these challenges, there is a need for innovative learning media to support the teaching and learning process. One promising solution is the development of interactive multimedia-based learning media. Such media offer several advantages, including enhancing student engagement, improving interactivity, increasing learning quality, and enabling flexible learning in terms of time and location. Well-designed learning media can also improve students' understanding and mastery of course materials, even in the absence of face-to-face instruction. As stated in previous studies, learning media serve as an important source of knowledge, allowing students to receive information and construct new understanding effectively [2].

Based on the aforementioned considerations, this study aims to develop a video animation-based learning media for the Steel Structure course, entitled "Development of Video Animation-Based Learning Media for Steel Structure Courses."

RESEARCH METHODS

1. **Research Design**

   This study employed a Research and Development (R&D) methodology. According to previous studies, R&D is a research approach used to develop a new product and subsequently evaluate its effectiveness. The development procedure in this study followed the 4D model proposed by Thiagarajan (1974), which consists of four stages: Define, Design, Development, and Dissemination [3].

   In this research, the developed product was a video animation-based learning media for the Steel Structure course. This instructional media is expected to serve as an alternative learning resource for students during online learning. In addition, it is intended to support lecturers by providing an innovative instructional tool to effectively explain course materials, particularly those that are difficult to demonstrate through conventional online teaching methods [4].

2. **Research Setting and Duration**

   This study was conducted in the Department of Civil Engineering, Faculty of Engineering, *Universitas Negeri Padang* (UNP), Indonesia, from October 2020 to October 2021. The research aimed to evaluate the feasibility (validity) of the developed product through expert validation (subject-matter and media experts) and to obtain user evaluations from students who had previously taken the Steel Structure course.

3. **Research Subjects**

   The subjects of this study were divided into two categories: validation subjects and trial subjects.

   a. Validation Subjects

      The validation subjects consisted of: Subject-Matter Experts: Two lecturers who teach the Steel Structure course. These experts were responsible for evaluating the accuracy, relevance, and depth of the learning content, as well as its alignment with instructional objectives. Media

Expert: One lecturer specializing in instructional media. The media expert evaluated the product in terms of visual design, presentation, and overall media quality using a structured questionnaire [5].

b. Product Trial Subjects

The trial subjects included: Lecturers: Three lecturers responsible for teaching the Steel Structure course. Students: A total of 40 students from the Building Engineering Education program, consisting of: 20 students who had experienced face-to-face learning, and 20 students who had participated in online learning. According to Arikunto (2019) [6], small group trials typically involve 4–14 respondents, while large group trials involve 15–50 respondents. Therefore, the number of participants in this study meets the criteria for large group trials.

4. **Instruments and Data Collection Techniques**

The data collection instrument used in this study was a questionnaire. A questionnaire is a data collection technique that involves providing a set of written questions or statements to respondents to obtain their responses. The questionnaires were administered to subject-matter experts, the media expert, lecturers, and students who had taken the Steel Structure course. The instrument consisted of structured statements developed based on relevant theoretical frameworks. Responses were measured using a four-point Likert scale, consisting of the following categories: Very Good, Good, Poor, Very Poor [7]. Each item in the questionnaire was assigned a score according to predetermined criteria, as presented in Table 1.

Table 1. The Scoring Criteria for the Questionnaire Items were Based on a Likert Scale

Criteria	Score
Strongly Agree	4
Agree	3
Disagree	2
Strongly Disagree	1

5. **Research Procedure**

According to Endang Mulyatiningsih (2012), the research procedure in this study was adapted from the 4D development model, which consists of four stages: Define, Design, Development, and Dissemination. The detailed procedures are described as follows:

a. Define Stage

1) Background Analysis

This stage aimed to identify the core problems, key issues, and learning needs. The analysis was conducted in the Department of Civil Engineering, Faculty of Engineering, *Universitas Negeri Padang.* It involved identifying constraints in the teaching and learning process, particularly during online learning conditions.

2) Objective Analysis

This analysis was carried out to determine the necessity of developing a learning media product to address the identified problems in the Steel Structure course during the COVID-19 pandemic. The data were collected through interviews with course lecturers and field observations.

b. Design Stage

The purpose of this stage was to organize and structure the learning materials. The content included in the product was determined based on consultations with the lecturers of the Steel Structure course and relevant literature sources. After organizing the material systematically, a storyboard was developed as a guideline for producing the instructional media. This storyboard served as a framework to ensure that the content delivery and visual presentation were coherent and aligned with the learning objectives [8].

c. Development Stage

1) Media Production

At this stage, the product was developed through several steps. First, the researcher recorded the steel tensile testing process in a workshop. Then, an animated video was created using Sparkol VideoScribe software. After completing both components, the videos were

integrated into a single instructional media product. The development process strictly followed the previously designed storyboard to ensure consistency and clarity.

2) Validation and Revision

Once the product was completed, it was subjected to validation by subject-matter experts in the Steel Structure course, followed by validation by a media expert. The feedback and evaluation results obtained from these experts were used as the basis for improving and refining the product [9].

3) Field Testing

Field testing was conducted by involving students as users of the developed media. Students were asked to use the product and provide their evaluations through a questionnaire. This stage aimed to obtain user feedback, suggestions, and corrections regarding the quality and usability of the product.

d. Dissemination Stage

At the final stage, once no further revisions were required, the final product was produced in the form of a video animation-based learning media for the Steel Structure course. The product was packaged in a compact disc (CD) format and equipped with a cover that reflects the content of the video.

6. **Data Analysis Techniques**

This study utilized two types of data: qualitative data and quantitative data. Qualitative data were obtained from comments, suggestions, and feedback provided by subject-matter experts and the media expert. Quantitative data were derived from the scores assigned to evaluate the feasibility of the learning media [10]. To determine the feasibility of the developed learning media, the following steps were carried out:

a. Recapitulating the collected data from all respondents.
b. Calculating the mean score for each indicator using the following formula:

$$X = \frac{\sum X}{n}$$

Where:
X = Mean Score
$\sum X$ = Total Score Obtained
n = Numbers of Respondents

RESULTS AND DISCUSSION

1. **Research Results**

a. Evaluation by Subject-Matter Experts

The content evaluation of the developed learning media was conducted by two subject-matter experts, namely Fajri Yusmar, S.T., M.T. and Annisa Prita Melinda, S.T., M.T., who are lecturers with expertise relevant to the presented material, particularly on tension members in the Steel Structure course. Based on the evaluation results, the first subject-matter expert assigned a score of 3.28, which falls into the “very good” category. Similarly, the second subject-matter expert also assigned a score of 3.28, indicating a “very good” level of quality.

b. Evaluation by Media Expert

The media evaluation in this study was conducted by a media expert, Fani Keprila Prima, S.Pd., M.Pd.T., a lecturer with expertise in instructional media. The evaluation results show that the developed product obtained a score of 3.65, which is categorized as “very good.” This indicates that the media design, visual presentation, and overall quality of the instructional media are highly appropriate for learning purposes.

c. Evaluation by Course Lecturers

The evaluation of the learning media was also carried out by three lecturers responsible for teaching the Steel Structure course, namely: Prima Zola, S.T., M.T., Dr. Eng. Prima Yane Putri, S.T., M.T., Fajri Yusmar, S.T., M.T. These lecturers assessed the media based on its relevance and effectiveness in delivering the topic of steel tension members within the Steel Structure course.

Based on the evaluation results, the first course lecturer assigned a score of 3.79, which falls into the "very good" category. The second lecturer provided a score of 3.36, also categorized as "very good." Meanwhile, the third lecturer assigned a score of 3.49, which likewise falls within the "very good" category. These results indicate that the developed learning media is highly appropriate and effective from the perspective of lecturers responsible for teaching the Steel Structure course.

d. Evaluation by Students

The evaluation of the video animation-based learning media was conducted using a large-group trial involving 40 students. The participants were divided into two groups: 20 students who attended face-to-face learning, and 20 students who participated in online learning. Due to the ongoing online learning conditions, the data collection process was conducted through online questionnaires. The results showed that the evaluation from the 20 students in the face-to-face group obtained a mean score of 3.15, which is categorized as "very good." Meanwhile, the evaluation from the 20 students in the online learning group yielded a mean score of 3.23, also categorized as "very good." The overall average score, calculated from both groups, was 3.19, which falls into the "very good" category. These findings indicate that the developed learning media is well-received by students and is considered effective in supporting both face-to-face and online learning environments.

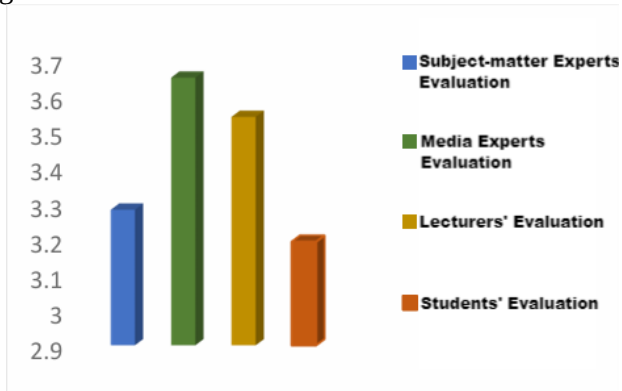

Figure 1. Research Results Chart

2. Discussion

The Steel Structure course is a 3-credit course designed for undergraduate students in the Building Engineering Education (PTB) program. The product developed in this study is a video animation-based learning media with a total duration of 12 minutes and 23 seconds, a file size of 549 MB, and a resolution of 1080p for the steel tensile testing animation. In addition, the animation related to tension members is divided into three parts. The first video has a duration of 11 minutes and 00 seconds, with a file size of 490 MB and a resolution of 1080p. The second video has a duration of 8 minutes and 4 seconds, with a file size of 357 MB and the same resolution. The third video has a duration of 11 minutes and 00 seconds, with a file size of 353 MB, also presented in 1080p quality. This learning media can be accessed through various electronic devices, such as laptops, personal computers, and smartphones, making it flexible and accessible for students.

The implementation of the video animation-based learning media was carried out during the third and fourth meetings. In the third meeting, the lecturer begins by introducing the topic, followed by the presentation of the animation video. Subsequently, students were able to perform the steel tensile testing practicum in the workshop under the supervision of the lecturer. In the fourth meeting, the lecturer again utilized the animation video to explain the material in more detail, reinforcing students' understanding. A learning media cannot be considered effective or appropriate without undergoing evaluation by experts. This is consistent with previous studies, which emphasize the importance of validation using specific assessment criteria before implementation. In this study, subject-matter experts evaluated the accuracy and relevance of the content presented in the media, while the media expert assessed the visual design, presentation quality, and editing process.

In line with the rapid advancement of technology and scientific development, there is an increasing need for alternative learning media that can adapt to these changes. The video animation-based learning media developed in this study represents an innovative solution that aligns with

current technological trends. Besides, this media is expected to assist lecturers in overcoming challenges in the teaching and learning process, particularly in delivering complex materials without requiring direct face-to-face interaction. This is especially relevant for courses such as Steel Structure, where practical demonstrations are essential but difficult to conduct during online learning. Therefore, the developed media serves as an effective alternative to enhance students' understanding and support both online and blended learning environments.

CONCLUSION

This study was conducted in accordance with its primary objective, which is to develop a video animation-based learning media for the Steel Structure course. In addition, the study aimed to determine the feasibility level of the developed media for use in both online and face-to-face learning environments, as well as to facilitate lecturers in delivering course materials and to enhance students' understanding of the subject matter.

Based on the evaluation results, the assessment by the first subject-matter expert yielded a score of 3.28, which falls into the "very good" category. Similarly, the second subject-matter expert also assigned a score of 3.28, categorized as "very good." Meanwhile, the evaluation by the media expert resulted in a score of 3.65, which is also classified as "very good."

Therefore, it can be concluded that the developed video animation-based learning media for the Steel Structure course is highly feasible and appropriate for use in the teaching and learning process. The media demonstrates strong potential to support effective learning, particularly in facilitating material delivery and improving students' comprehension.

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