CIVED Journal of Civil Engineering and Vocational Education

EISSN: 2622-6774
Vol 11 No.1 March 2024
http://cived.ppj.unp.ac.id/index.php/CIVED

Manufacture of a Simple One-Way Vibration Table and Earthquake-Safe Structure Model as Props in The Strengthening Structural Method

Galuh Wulandari[1], Eka Juliafad[2*]
[1,2] Civil Engineering, Faculty of Engineering, Universitas Negeri Padang, Indonesia
[*] Corresponding author, e-mail: ekajuliafad@ft.unp.ac.id

Received 14th Jan 2024; Revision 28th Jan 2024; Accepted 19th Feb 2024

ABSTRACT

The problem raised is the absence of earthquake-safe structural props as learning support, so students still struggle to describe the behavior and effects of earthquakes on buildings. This research aims to produce earthquake-safe structural props media that are feasible to use as learning support media in the Structural Reinforcement Methods course. This research uses the Research and Development method, which adapts the DDD-E model, which consists of the Decide, Design, Develop, and Evaluate stages. The instrument used in this research is an assessment questionnaire for the media validation and practicality tests. Based on the product assessment of the earthquake-safe structure props media in the course of Structural Reinforcement Methods with the Aiken formula by media experts from all aspects obtained a V Aiken value of 0.87 with valid criteria, and the assessment by material experts from all elements received a V Aiken value of 0.96 with valid criteria. At the same time, students' practicality test of the earthquake-safe structure props media obtained a percentage value of 87% with very practical criteria. Therefore, the produced media can be declared very valid and applicable as learning support media.

Keywords: *Learning media; Validity; Practicality; Reinforcement method structure.*

INTRODUCTION

Indonesia is an earthquake-prone region. The September 30, 2009 earthquake that shocked West Sumatra and even the world is still vivid in our minds. The earthquake's epicenter, which measured 7.6 on the Richter scale, shook the coastal areas of West Sumatra. This natural phenomenon occurred by providing lateral pressure that could damage building materials and cause casualties. The level of earthquake vulnerability (risk) in each region is different because the vibration energy varies from low to high risk [1]–[4]. It was increasing in danger level from low to high. Because earthquake vibrational energy travels throughout the earth, damage occurs through a mechanism.

Many structures collapsed during the earthquake due to subpar preparation or execution or possibly because they had not been built to withstand earthquakes. Following this incident, people became aware of the risks associated with earthquakes and the requirement for designing earthquake-resistant buildings. A structure that can respond to earthquakes in a way that prevents collapse and is adaptable enough to attenuate local vibrations is said to be earthquake-safe. An analytically computed design, including the mix of material utilization and structural arrangement, results in an earthquake-safe construction.

EISSN: 2622-6774
Vol 11 No.1 March 2024
http://cived.ppj.unp.ac.id/index.php/CIVED

A course on structural reinforcement methods is required in the Padang State University's Department of Civil Engineering. This course gives students knowledge, skills, and abilities in the area of structural reinforcement, including identifying and analyzing the flaws and degree of structural damage, analyzing and designing techniques for reinforcing earthquake-safe home or building structures like columns, beams, walls, and roof trusses, as well as soil reinforcement and building reinforcement using base isolation following SNI.

One strategy professors employ to build rapport with students and facilitate learning is using learning material. Learning media is a crucial component of the teaching and learning process to achieve educational goals in general and school learning goals in particular. An instrument for spreading messages or information is the media. [5]. Support is required to facilitate this learning, including planning, setting up conducive learning environments, providing learning activity aids, media, methodologies, and effective presenting strategies. To accomplish the established teaching objectives, subject matter refers to the subject and description of the knowledge in the curriculum that the instructor must impart to students during the learning process [6].

Teaching aids can help pupils put their abstract concepts into concrete form. Using teaching aids in the classroom fosters engaging and productive learning [7]. To help students grasp the material being taught, comprehend the lesson clearly, or master the skills and substance of a practical study, teaching aids are necessary. Each instructional tool must, of course, be used in conformity with the learning objectives. Because using too many props may hinder students' ability to think abstractly, and verbalistic learning will be dull [8]. Tools and props are the two terms from which the word "props" is derived. A tool is an item with a particular purpose, but a prop is anything utilized to demonstrate or give physical form to an idea that needs to be expressed. This physical form can take the shape of real objects, artificial objects, models, or visual or audio-visual representations [9].

At the State University of Padang's Department of Civil Engineering, a course on Structural Reinforcement Methods must be taken. Students who complete this course will have structural strengthening knowledge, skills, and abilities. The course aims to help students comprehend the causes of structural damage, one of which is earthquakes, including definitions, earthquake parameters, earthquake sources, and the effects of earthquakes on buildings. The course also aims to help students understand the criteria for earthquake-safe buildings (such as geometric requirements) and the technical specifications for such structures.

For more than 30 years, various strategies and methods have been studied and implemented to improve structures. A few of these are increasing the structure's stiffness and modifying it by removing or minimizing anomalies in the distribution of stiffness and strength in the building structure. Techniques for structural strengthening are intended to enhance and improve the performance of structures' strength and ductility. Using a shaking table simulator trainer constructed and designed to replicate real earthquake vibrations, the response of a structure to an earthquake can be assessed. An earthquake simulator trainer often uses a vibrating table and a drive like a motor or hydraulic actuator to model the response of a building structure. Depending on the type of vibration excitation used for development, simulation, production, and studying the effects of vibration to evaluate physical and structural properties, the designed vibrating table is an essential tool in testing to analyze and even diagnose the vibration and failure of specific structural test objects.

Journal of Civil Engineering and Vocational Education
EISSN: 2622-6774
Vol 11 No.1 March 2024
http://cived.ppj.unp.ac.id/index.php/CIVED

The earthquake simulator trainer's vibration principle may vary depending on the component. While employing the motion of the base principle in the part between the motor and the floor, the base isolation principle is used in the section between the load structure and the vibrating table. Because the earthquake waves are sinusoidal waves and the vibrations from the vibrating table produce translational motion, the earthquake simulator trainer applies a simple mechanism considering the building structure used on a small scale. As a result, the vibrations produced in the earthquake simulator trainer are sinusoidal (repeated) oscillations [10].

METHODS

The Decide, Design, Develop, and Evaluate (DDD-E) development approach will be used in research and development (R&D). This strategy consists of four parts, starting with Decide, which involves examining the goals for the materials, media, and intended targets. Making the media's display and content is referred to as design. Develop is a verb that refers to creating media in accordance with a prior design. And Evaluate, which is a process of evaluation done at both the final level and each stage of development. After students have used the media that the validator has deemed valid, there will be a practicality test in the last phase that will be conducted by administering a questionnaire to the students [11].

This study was carried out from July to December 2023 at the Padang State University's Faculty of Civil Engineering in Padang City, West Sumatra. If the product satisfies the media requirements regarding media elements and material aspects, it can be characterized as valid and usable. The practicality test also aims to obtain data about the practicality of the media products made, not only to produce precise data but also a valid and practical measuring instrument, and must carefully describe the data. Validity is a degree of determination between the data in the research object and the power that researchers can report[12].

Three lecturers or learning media experts assist an experienced media lecturer validate products. The role of the media expert is to evaluate the product, as shown by completing a questionnaire about the media, along with a Material Expert lecturer by three lecturers or experts in the field of material in the Structural Reinforcement Method lectures and Padang State University Civil Engineering study program students who are enrolled in the July–December 2023 semester Structural Reinforcement Methods course, the number of students who were used as evaluation subjects were 29.

a. Validation

   Data obtained from validators after conducting validation will be analyzed using the formula listed below [13]:

$$V = \frac{\sum s}{n(c-1)}$$

   Description:
   V = Validity Index
   S = r - lo (the score set by the rater minus the lowest score)
   n = Number of Raters
   c = Highest Validity assessment number

   After analyzing the score data, a quality category can be obtained according to the size of the validity value obtained in the following table:

CIVED Journal of Civil Engineering and Vocational Education
EISSN: 2622-6774
Vol 11 No.1 March 2024
http://cived.ppj.unp.ac.id/index.php/CIVED

Tabel 1. Validation Category

No	Level of Validity	Category
1.	0 – 1,00	Valid
2.	<0	In Valid

b. Practicality

The data obtained from filling out the questionnaire will then be analyzed using the formula below [14]:

$$Skor = \frac{Jumlah\ skor\ yang\ diperoleh}{Jumlah\ skor\ maksimal} \times 100\%$$

According to the amount of the percentage gained, the score data that has been examined can be obtained according to the quality category. The following table lists the score interpretation standards applied in the study:

Tabel 2. Percentage of Practicality Assessment

Rating Level Category	Category
81-100	Very Practical
61-80	Practical
41-60	Moderately Practical
21-40	Not Practical
0-20	Not Very Practical

RESULTS AND DISCUSSION

Research and Development (R&D) method refers to the DDD-E development model, where the stages are as follows:

A. Decide

1. Create learning objectives for the Structural Reinforcement Methods course tailored to the semester learning plan (SSP), focusing on the content for recognizing structural flaws and damage and their causes, particularly earthquakes.
2. Select the media's theme to be used in the instructional procedure. Researchers in this study decided to create learning materials based on objects rather than traditional props.
3. Set the target population as students enrolled in the Civil Engineering study program at Padang State University who took the Structural Reinforcement Methods course.
4. After every aspect has been decided, a formative evaluation of the learning material to be used, explicitly identifying structural defects and damage and their unique causes, such as earthquakes in the Structural Reinforcement Methods course, is conducted at the deciding stage.

B. Design

This phase consists of several steps:

1. When making a flowchart, the information on identifying damage and defects in structures includes a schematic or flow of how earthquake-safe structural props are employed.

Journal of Civil Engineering and Vocational Education
EISSN: 2622-6774
Vol 11 No.1 March 2024
http://cived.ppj.unp.ac.id/index.php/CIVED

2. Create the appearance of the props, or, to put it another way, a complete blueprint of the media props that will be manufactured in the future.
3. During the formative evaluation stage of design, the flowchart and display design that will be used to construct learning media props are assessed.

Figure 1. View Design

Figure 2. Part of a prop

a. Develop

This phase consists of several steps, namely:

1) Started by creating the instructional aids media components. The concept of media presentation that was chosen at the previous stage will also be applied in practice in the future by creating products in the form of instructional aids.
2) Instrument creation, such as creating surveys for product validation, practicality, or student reaction, is the next step.
3) At this stage of development, formative evaluation is carried out by doing validation tests on the instrument and media validation testing on the props. The review of the props media validation test is described as follows:
   a) Assessment of the material expert:

EISSN: 2622-6774
Vol 11 No.1 March 2024
http://cived.ppj.unp.ac.id/index.php/CIVED

Tabel 3. Material Validation Result.

Aspect of Assessment	Validation Value	Category
Suitability of Material with SSP	1	Valid
Accuracy of the Material	1	Valid
Supporting Material	0,89	Valid
Grand Total	0,96	Valid

The media for earthquake-safe structure props is categorized as valid based on the assessment conducted by the material expert validator, which obtained a V Aiken value of 0.96, which is classified as valid.

b) Assessment of the media expert:

Table 4. Media Validation Result.

Aspect of Assessment	Validation Value	Category
Simplicity	0,93	Valid
Balance	0,70	Valid
Cohesiveness	0,92	Valid
Form	0,93	Valid
Grand Total	0,87	Valid

The media for earthquake-safe structure props is categorized as valid based on the assessment conducted by the media expert validator, which obtained a V Aiken value of 0.87, which is classified as valid.

b. Evaluate

The evaluation process is completed by running a media practicality test that professionals have approved. Students in the Civil Engineering study program who studied the Structural Reinforcement Methods course at Padang State University between July 2023 and December 2023 were given a response questionnaire as part of the practicality test.The practicality test aimed to ascertain the student evaluation of learning media products in the form of teaching resources on research-produced materials for earthquake-safe structures. The results of filling out the questionnaire can be seen in the following table:

Table 5. Assessment results by students.

Aspect of Assessment	Practicality Value %	Category
Display	88%	Very Practical
Ease of use	86%	Very Practical
Time	88%	Very Practical
Grand Total	87%	Very Practical

EISSN: 2622-6774
Vol 11 No.1 March 2024
http://cived.ppj.unp.ac.id/index.php/CIVED

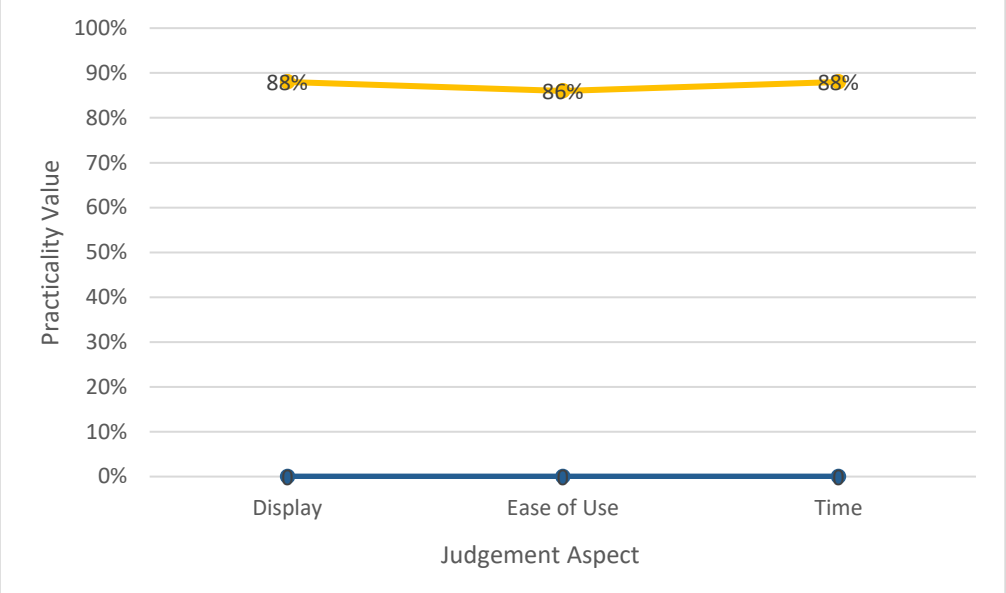

Figure3. Graph of student practicability results

Students in the Civil Engineering study program scored an overall average of 87% on the practicality test, with a very practical category. The earthquake-safe structural props media are practicable and suitable for use as a learning aid, according to the criteria found in the practicality test.

Discussion

This manufacturer's research results are used to create instructional aids that are learning media items. To foster a pleasant and engaging learning environment, this research aimed to develop learning media that can assist learning activities in the Structural Reinforcement Methods course, particularly on earthquake-safe structural material.

The data in the table above shows that the media quality for earthquake-safe structure props is categorized as valid based on the assessment carried out by material expert validators and media experts, so it can be inferred that the material and media made are appropriate and in line with "in choosing learning media, it must be adapted to the material and characteristics of the students" [15].

It can be seen that the media practicality test receives a score of 87% with a convenient category after the validity of the media is tested, and it can be inferred that the media products designed following the function of learning media are a means of rousing student motivation to learn so that students more easily understand the subject matter [16].

CONCLUSION

The results of the research that has been carried out can be concluded that learning media has been produced in the form of earthquake-safe structure props in the Structural Reinforcement Methods Course at the Department of Civil Engineering, Padang State University, using the type of research (R&D) with the DDD-E model, namely Decide, Design, Develop, and Evaluate in the Structural Reinforcement Methods course.

According to the results of the validation assessment conducted by media experts and material experts, the teaching aids are declared valid based on acquiring a validity value from media experts of 0.87 based on the Aiken V formula, which includes valid criteria from simplicity, balance, integration, and shape. Furthermore, the validity value of the material expert is 0.96 based on the Aiken V formula, which includes valid criteria from the aspects of the suitability of the material with the RPS, the accuracy of the material, and supporting material.

The earthquake-safe structure props media passed the practicality test in the Structural Reinforcement Methods course and based on the acquisition of a practicality value with a percentage of 87%, which includes very practical criteria from the aspects of appearance, ease of use, and time, it was declared to be very practical to use.

REFERENCE

[1] E. Juliafad and H. Gokon, "SEISMIC FRAGILITY FUNCTION FOR SINGLE STOREY MASONRY WALL RC BUILDING IN PADANG CITY, INDONESIA," International Journal of GEOMATE, vol. 22, no. 94, pp. 39–46, Jun. 2022, doi: 10.21660/2022.94.3160.

[2] A. Komala and E. Juliafad, "EVALUASI KUAT TEKAN BETON EKSISTING PADA BANGUNAN GEDUNG B SEKOLAH DASAR NEGERI 09 PASAMAN," 2022.

[3] L. J. Restu, E. Juliafad, and F. Yusmar, "EVALUASI STRUKTUR BANGUNAN PASAR INPRESS BLOK IV GEDUNG B DENGAN METODE PUSHOVER," 2021. [Online]. Available: http://ejournal.unp.ac.id/index.php/cived/index

[4] M. Maulana and E. Juliafad, "Evaluasi Displacement Horizontal Pasar Raya Padang Blok IV Berdasarkan Gaya Gempa Pada SNI-03-1732-2019," INVOTEK: Jurnal Inovasi Vokasional dan Teknologi, vol. 22, no. 1, pp. 61–72, Aug. 2022, doi: 10.24036/invotek.v22i1.930.

[5] Sanaky, H. A. (2013). Media pembelajaran interaktif-inovatif. Yogyakarta: Kaukaba Dipantara, 3.

[6] Sadiman, A. S. (2011). dkk, Media pendidikan. Jakarta: PT Raja Grafindo Persada.

[7] Arsyad, A. (2014). Media Pembelajaran. Depok: PT. Raja Grafindo Persada.

[8] Sari, A. G. P. (2022). Komparasi Penggunaan Alat Peraga Jaring-jaring Makanan terhadap Minat Belajar Siswa Kelas V di MI Ma'arif Ngrupit (Doctoral dissertation, IAIN Ponorogo).

[9] Sadiman, A. S. (2011). dkk, Media pendidikan. Jakarta: PT Raja Grafindo Persada.

[10] Utomo, W. C. (2018). Rancang Bangun Translational Shaking Table (TST) dan Analisis Pengaruh Massa Unbalance, Jarak Eksentris, dan Frekuensi terhadap Respon Dinamis pada Translatinal Shaking Table (Doctoral dissertation, Institut Teknologi Sepuluh Nopember).

EISSN: 2622-6774
Vol 11 No.1 March 2024
http://cived.ppj.unp.ac.id/index.php/CIVED

[11] Tegeh, I. M., Jampel, I. N., & Pudjawan, K. (2014). Model penelitian pengembangan. Yogyakarta: Graha Ilmu, 88, 90-92.

[12] Sugiyono. (2017). Metode Penelitian Kuantitatif, Kualitatif, dan R&D. Bandung: Alfabeta.

[13] Aiken, L. R. (1985). Three coefficients for analyzing the reliability and validity of ratings. Educational and psychological measurement, 45(1), 131-142

[14] Riduwan, S. (2015). Pengantar Statistika Untuk Penelitian Pendidikan, Sosial, Ekonomi, Komunikasi, dan Bisnis. Cetakan Ke-4 Bandung: Alfabeta.

[15] Aqib, Z. (2013). Model-model, media, dan strategi pembelajaran kontekstual (inovatif). Bandung: yrama widya.

[16] Suprihatiningrum, J. (2013). Strategi pembelajaran teori dan aplikasi. Yogyakarta: Ar-ruzz media.