Digital Game to Support the Effectiveness of Using Interactive e-Module on Vibration and Waves Concept (IeMVWC)

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ABSTRACT

Digital games have the potential to increase the effectiveness of using interactive e-modules. This development research aims to produce an interactive e-module on vibration and waves concept (IeMVWC) assisted by digital games, as well as investigate the impact of its use on student learning achievement. This development research follows the ADDIE stages (Analyze, Design, Develop, Implement, and Evaluate). The data collected in this study includes product validation data, learning achievement data, and student response data collected through validation sheets, multiple-choice questions, and questionnaires. The IeMVWC product assisted by digital games produced is declared very feasible for use in learning and effective in improving student learning achievement in vibration and wave learning.

Keywords: IeMVWC, Digital Games, Learning achievement, Vibration and waves

ABSTRAK

Game digital memiliki potensi dalam meningkatkan efektivitas penggunaan e-modul interaktif. Penelitian pengembangan ini telah dilakukan dengan tujuan untuk menghasilkan produk *e-modul* interaktif pada konsep getaran dan gelombang (IeMVWC) berbantuan *game* digital serta menyelidiki dampak penggunaannya terhadap prestasi belajar siswa. Penelitian pengembangan ini mengikuti tahapan ADDIE. Data yang dikumpulkan dalam penelitian ini meliputi data validasi produk, data prestasi belajar dan data tanggapan siswa yang dikumpulkan melalui instrumen lembar validasi, soal-soal pilihan ganda dan angket. Produk IeMVWL berbantuan *game* digital yang dihasilkan dinyatakan sangat layak untuk digunakan dalam pembelajaran dan efektif dalam meningkatkan prestasi belajar siswa pada pembelajaran getaran dan gelombang.

Kata kunci: IeMVWC, *Game* digital, Prestasi belajar, Getaran dan gelombang

INTRODUCTION

With the increasingly sophisticated development of digital media technology, the paradigm of using learning resources has shifted from print media to digital media such as e-books (Saprudin et al., 2021; Haji et al., 2021), e-modules (Saprudin et al., 2022; Wahab et al., 2023; Marinda et al., 2023; Hamid et al., 2023), interactive multimedia (Saprudin & Hamid, 2018), and mobile apps (Saprudin et al., 2023). Through the development of digital teaching materials, learning materials can be presented in a more interesting, varied, and interactive way (Yusuf et al., 2023). With this advantage, students can be motivated to study material content in-depth

and can provide visualization for abstract concepts. One abstract concept that requires visualization is the concept of vibration and waves (Fauziyah et al., 2019).

The concept of vibration and waves is one of the science lesson content that is considered difficult for students to learn (Fauziyah et al., 2019; Pratiwi et al., 2022). The abstract characteristics of the material are one reason why this material is difficult for students to learn (Purwaningsih, 2015). In previous research, it was found that students experienced misconceptions and difficulties in solving problems related to vibration and wave material (Astuti et al., 2020; Haliza & Hadi, 2022; Haerunnisa et al., 2022). Therefore, the content of vibration and wave material has to be presented more varied and interactive in the form of text, images, audio, animation, video, quizzes, simulations, e-worksheets, digital games, and also automatic assessments. Interactive e-modules are one form of digital media product that can be developed for this purpose.

In teaching science concepts, especially physics concepts, interactive e-modules have been widely used, such as in linear motion material (Saputra et al., 2020), kinetic gas theory (Putri et al., 2020), dynamic electricity (Sulthon et al., 2020), momentum (Shobrina et al., 2020), sound waves (Novitasari et al., 2021), and also momentum and impulse (Savira et al., 2019). In previous research, an interactive e-module on vibration and waves concept (IeMVWC) has been produced which has a positive impact on improving student learning achievement (Saprudin et al., 2022; Marinda et al., 2023). To increase student interest and engagement in the e-module product produced, it is necessary to add digital game elements.

Games are any contests that create interaction between players by following existing rules that have been determined in achieving a goal (Sadiman et al., 2010). Games can also be seen as an online environment that can involve someone in competitive activities with challenges to achieve goals, rules, and limitations, and also in certain contexts (Clark & Mayer, 2011). In other references, games can be interpreted as a system where players can engage in intellectual challenges, determined by rules, interactivity, and feedback that can produce measurable results, and often evoke emotional reactions (Kapp, et al., 2014). Therefore, games can also be seen as tools in learning, evaluation tools, and also as learning environments (Saprudin et al., 2017). The use of games in science learning, especially physics, has been proven to increase motivation (Hwang et al., 2014; Killingsworth, et al., 2015) and student learning achievement (Chen, et al., 2015; Tsai, et al., 2016). In other references, the use of games can increase student engagement (Hamari, et al., 2016) and create a fun learning atmosphere (Kim & Shute, 2015).

In the results of observations at one of the Junior High Schools in the city of Ternate, it was found that the learning that was carried out was considered less interesting and less challenging. Vibration and wave material is felt difficult to learn, let alone studied independently outside of school hours. One potential that can be utilized is the recognition that students like and enjoy playing digital games. Although the use of games in learning is still limited, such as in quizzes, smart matches, or also matching pairs of question and answer cards, these activities can create a fun learning atmosphere and students feel happy to follow the learning. Other findings show that students feel lazy and bored studying lesson material independently outside of school hours.

In this study, IeMVWC assisted by digital games was developed with several research questions as follows; 1) how is the feasibility of IeMVWC assisted by digital games developed in this study?, 2) what is the impact of using IeMVWC products assisted by digital games on improving student learning achievement?. In this study it was also investigated regarding how the student's response to the use of IeMVWC products resulted from this research.

METHODOLOGY

This study uses a research and development approach, following the ADDIE stages which include the Analyze, Design, Develop, Implement, and Evaluate stages (Branch, 2009).
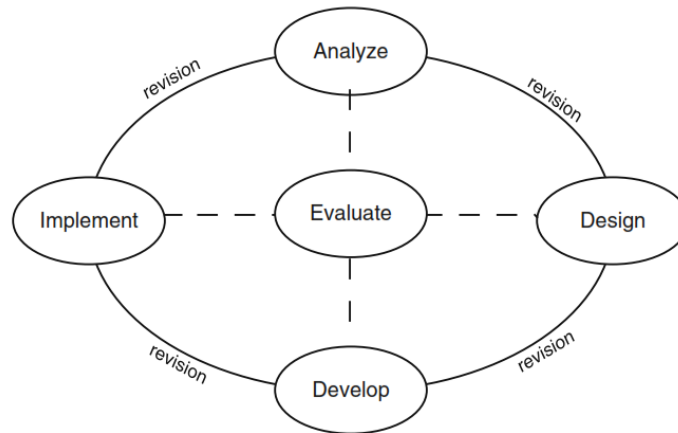

Figure 1. Common instructional design procedures organized by ADDIE (Branch, 2009)

Data collection for the validation of the IeMVWC assisted by digital games was carried out through a validation sheet involving media experts, material experts, and language experts. Implementation was carried out using a time series design involving 20 students (F = 10, M = 10) of class VIII at one of the Junior High Schools in the city of Ternate, Indonesia. Student learning achievement data was collected through a test instrument in the form of multiple-choice questions. In addition, student response data to the use of IeMVWC assisted by digital games was collected through a questionnaire instrument. Descriptive quantitative processing has been carried out to process product validation data and student responses. Meanwhile, data on improving student learning achievement was analyzed by calculating the normalized gain score (Hake, 1998).

RESULTS AND DISCUSSION

In the analysis stage, a literature study, curriculum analysis, analysis of junior high school science lesson material, and field studies were carried out. Vibration, wave, and sound materials are taught to junior high school students in grade VIII within the scope of basic competence 3.11, which is to analyze the concepts of vibration, waves, and sound in everyday life. However, in this study, the scope of the material developed is more focused on vibration and wave material. At the analysis stage, it was concluded that it was necessary to develop an interactive e-module on vibration and waves (IeMVWC) assisted by digital games.

In the design stage, a digital game storyboard, storyboard, and research instrument were produced. At this stage, elements needed for the completeness of IeMVWC assisted by digital games were also successfully collected, such as cover, core competencies, basic competencies, learning objectives, concept maps, materials, worksheets, sample questions, interactive quizzes, games, and evaluations. At this stage, research instruments were also produced which included a validation sheet for IeMVWC products and a test instrument for student learning achievement specifically on vibration and wave material.

In the development stage, the IeMVWC product assisted by digital games was designed using Flip PDF Corporate Edition 2.4.9.18 software. Meanwhile, digital games, it was designed using the Wordwall application. The IeMVWC product has been validated by media experts, material

experts, and language experts. Validation of research instruments was also carried out at the development stage.

In the implementation stage, the IeMVWC assisted by digital games was used in learning vibration and wave material involving 20 students of class VIII at one of the Junior High Schools in the city of Ternate. At this stage, measurements of student learning achievement and student responses to the use of IeMVWC products assisted by digital games in learning were carried out.

In the evaluation stage, data analysis and interpretation of the results of data analysis on student learning achievement and student responses to learning using the IeMVWC product developed in this study were carried out. At this stage, conclusions were also drawn regarding the research questions posed through this study.

Digital Game Description

The digital games used in this study were designed using the online Wordwall application, which can be accessed at https://wordwall.net/. The forms of games that have been created include Crossword, Maze Chase, and Group Sort. The appearance of the designed games is shown in Figures 2, 3, and 4.
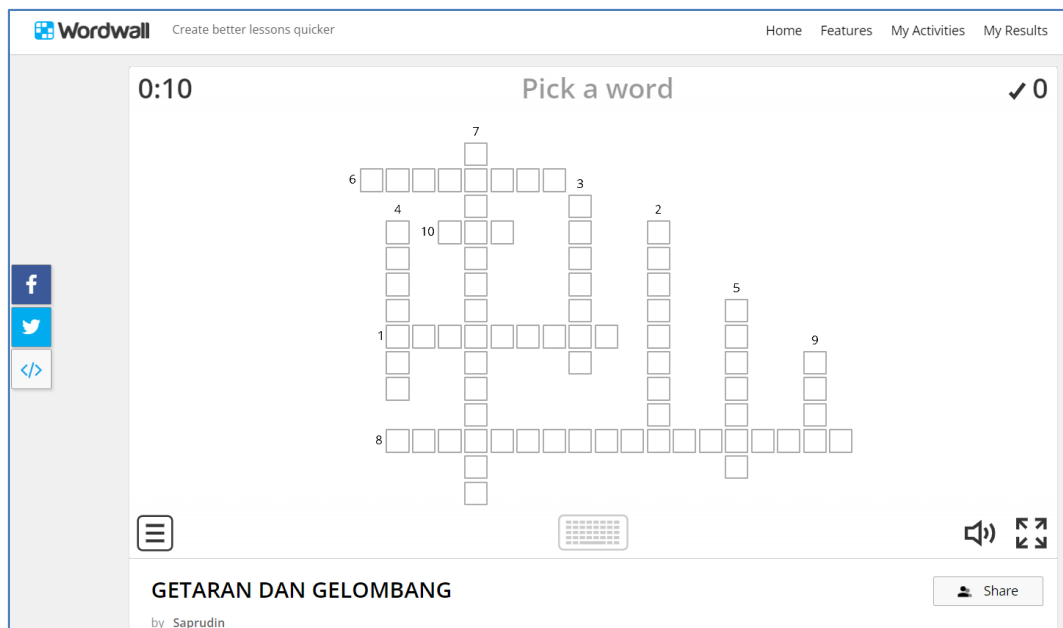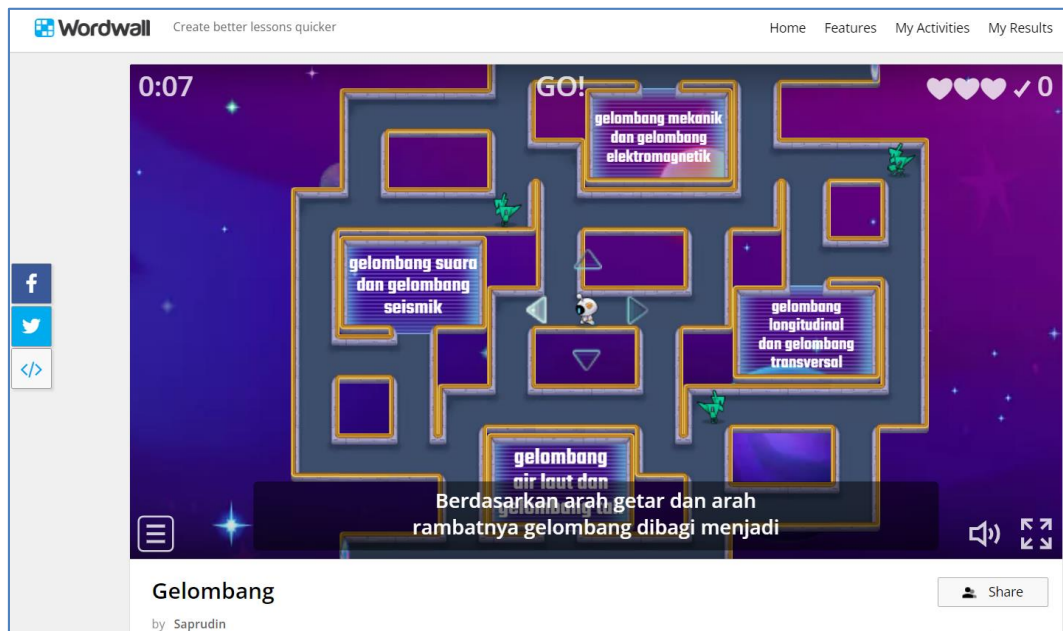

Figure 2. Crossword game (https://wordwall.net/resource/33532005)

Figure 3. Maze Chase Game (https://wordwall.net/resource/33588122)

Figure 4. Group sort Game (https://wordwall.net/resource/25273920)

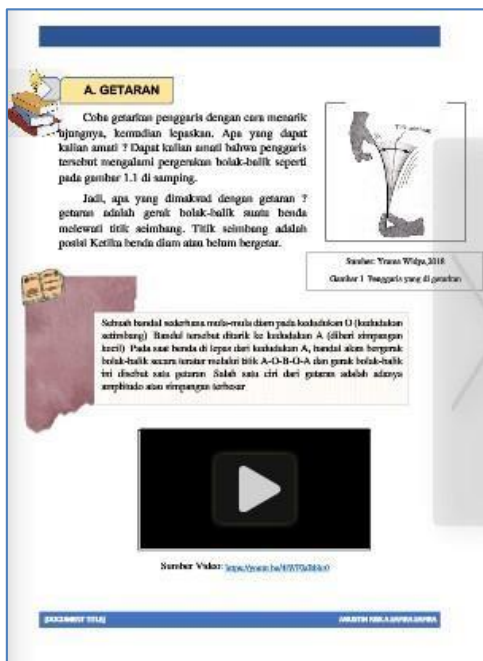## Description of IeMVWC Assisted by Digital Game

The IeMVWC assisted by digital games developed in this study presents vibration and wave learning material in the form of text, images, audio, video, animation, interactive simulations, interactive quizzes, student worksheets, games, and automatic assessment. The appearance of IeMVWC assisted by digital games is shown in Figure 5.
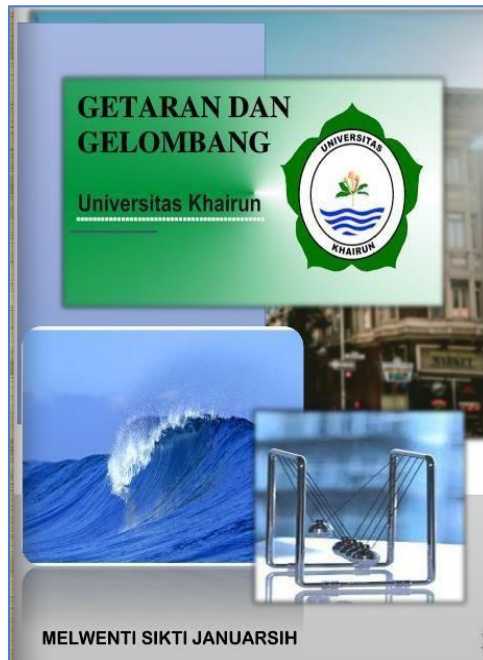
Figure 5. IeMVWC assisted by Digital Game

Results of Product Validation of IeMVWC Assisted by Digital Game

The results of the validation by media experts, material experts, and language experts are shown in Table 1. The IeMVWC assisted by digital games is declared "very feasible" for use in learning. Some product revisions done during the validation process include 1) revision of the learning objectives point, 2) adding visualization related to waves, 3) completing references, 4) adding a concept map, 5) adding practice questions, and 6) adding student worksheets.

Table 1. Results of the validation of IeMVWC assisted by digital games

Validator	Percentage (%)	Criteria
Media Expert	88	Very Feasible
Material Expert	88	Very Feasible
Language Expert	98	Very Feasible

Improvement of Student Learning Achievement

Implementation was done using a time series design and has been carried out until the third series. The pretest, posttest, and percentage of normalized gain scores are shown in Figure 6.
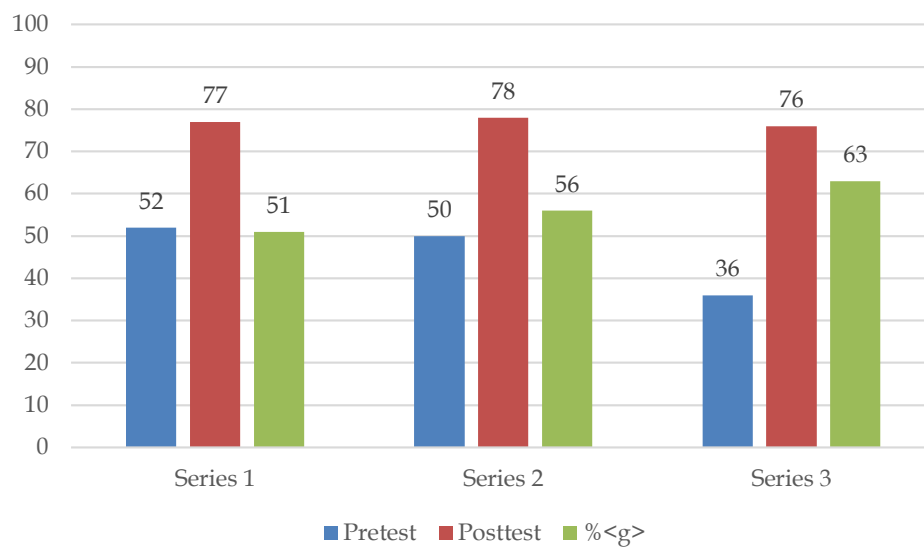

Figure 6. Pretest, posttest, and percentage of normalized gain scores

Student Response to IeMVWC Assisted by Digital Game

The results of the questionnaire analysis show that students gave a very good response to the use of IeMVWC assisted by digital games in classroom learning. For more details, student responses to the developed product can be shown in Table 2. Based on Table 2, it can be concluded that students gave a very good response to the use of IeMVWC products assisted by games in learning vibration and wave material.

Table 2. Student response to the use of IeMVWC in learning

No	Aspect	Percentage (%)
1	Student's learning motivation	100
2	Use of IeMVWC assisted by digital games	95
3	Use of games with the Wordwall application	100
4	Interest in studying vibration and wave concepts	95
5	Facilitates understanding of vibration and wave concepts	95
6	Facilitates the development of problem-solving skills	90
7	Facilitates independent student learning	95
	Average	96

Based on the assessment of the validators, the IeMVWC assisted by digital games is declared very feasible for use in teaching vibration and waves to junior high school students. This is shown by the large percentage of 88% from media experts and junior high school science material experts and 98% from language experts. The product has also been improved from various validator suggestions to produce a better product.

The IeMVWC product assisted by digital game that was produced successfully presents vibration and wave material that is more varied and interactive. The presence of digital game elements successfully attracts attention so that students are motivated to study the material (Killingsworth, et al., 2015). This increase in student motivation can ultimately have an impact on improving student learning achievement. In addition, the IeMVWC developed can present material more concisely, and clearly, and equipped with visualization of images and videos so that it can make it easier for students to understand vibration and wave material.

The IeMVWC product assisted by digital games produced has limitations including: 1) this product requires a computer to access it, 2) some features of the resulting IeMVWC such as digital game features require an internet connection to access it, 3) the product can only be accessed via a computer or laptop, so for wider access it needs to be developed in a mobile version. However, the IeMVWC product assisted by digital games that have been produced has advantages including 1) the material is presented more interestingly and interactively so that it can motivate students to study the material, 2) it can help students in organizing online learning during the covid pandemic and facilitate students to learn independently outside of school hours, 3) online games presented can help students like learning vibration and wave material more, and 4) elements of images and videos presented can provide visualization of vibration and wave concepts so that it makes it easier for students to understand these concepts.

CONCLUSION

In general, the IeMVWC product assisted by digital games is declared very feasible for use in teaching vibration and wave material. The learning achievement of students who participated in learning using the IeMVWC product from this study increased with a normalized gain score of 0.51 for the first series, 0.56 for the second series, and 0.63 for the third series. In general, student responses to the use of IeMVWC assisted by digital games were categorized as very good with a percentage of 96%. For future development, the IeMVWC product assisted by digital games needs to be designed to be accessible on mobile platforms.

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