Volume 8, Nomor 1, June 2024
Numerical: Jurnal Matematika dan Pendidikan Matematika
http://journal.iaimnumetrolampung.ac.id/index.php/numerical
DOI:https://doi.org/10.25217/numerical.v8i1.

Development of the "GAULL" Mathematics Learning E-Module Using Crossword Games on Flat-side Space Buildings

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Article Info
Article History:
Received: 29-05-2024
Revised: 05-07-2024
Accepted: 15-07-2024

Keywords:
Build a Flat Side Room;
Crossword Game;
E-Module;
GAULL

Abstract

Learning media is a very effective for teachers to improve the quality of learning and ensure that students can understand the material better. For this reason, it is necessary to design learning media that can facilitate students to understand the material being studied. This research aims to develop and implement a learning e-module by utilizing crossword games on the subject of flat-sided spatial construction for class VIII junior high school students, through a 4-D development research design, which are define, design (planning), develop (development), and dissiminate (distribution). E-module development utilizes facilities on the Heyzine website and other supporting applications such as Ms Word and Canva. The subjects of this research were 27 class VIII students at SMPN 1 Bulawa. The instruments used in this research were a questionnaire for media expert validation, a material expert validation questionnaire, a teacher respondent questionnaire and a student respondent questionnaire. The media expert validation results got a score of 3.55, including very valid criteria, while the material expert validation results got a score of 3.72 with the same criteria, which very valid. The results of the limited scale trial to see practicality through the teacher respondent questionnaire obtained a percentage of 97%, which the very practical criteria, while the student respondent questionnaire obtained a percentage of 93.57%, also included in the very practical criteria. Thus, the e-module developed is declared suitable for use and dissemination.

INTRODUCTION

Knowledge is very important for humans in improving a better quality of life. Formal and non-formal education are two different ways to obtain this knowledge. Formal education can be obtained through school education, and good education means that students can understand each subject well. Therefore, to increase the level of success of students, educators and students must interact with each other interactively. This especially applies to the field of mathematics, because students have low thinking skills in solving mathematical problems, which has an impact on their learning outcomes [1].

When learning in class, most of the mathematics modules used by teachers still use a conventional approach. In the conventional learning process, it is more teacher-centered, interaction is more one-way from teacher to student and focuses on mastering concepts and

Print ISSN: 2580-3573, Online ISSN: 2580-2437

competencies, rather than improving students' thinking abilities [2]. Therefore, e-modules must be provided to be a driving factor in students' learning motivation and improve their critical reasoning abilities, so that learning goals are achieved. Apart from that, teachers must also be competent in creating meaningful learning activities so that the learning process is fun and not boring. Because, having fun while learning, especially when learning mathematics, will develop students' interest in the lesson and make the material easier to absorb. This will certainly increase students' learning achievements and hone their critical thinking skills [3].

The teaching and learning process designed by the teacher influences the success of learning itself. A good learning atmosphere will influence student reactions. The learning process also depends on interactions involving teachers and students as well as students and other students. Using a learning model that is suitable to the characteristics of the material or concept being taught will make it easier for teachers to carry out their duties so that learning objectives can be achieved [4].

Learning media is a means for teachers to communicate and convey interesting information to students. Choosing the right media can provide optimal effects in achieving learning objectives. The use of media can make classes more interesting and enjoyable, so as to encourage student activity in the learning process. However, in reality in many schools, teachers have not utilized technological media such as websites and mathematics support applications to their full potential. As a result, students will encounter several difficulties in understanding the material, which results in a lack of attention to the development of their cognitive, affective and psychomotor domains [5].

One of the subjects that often faces various problems is mathematics, because students have many assumptions about mathematics which are very difficult to understand and boring [6]. Finding that the success of mathematics teaching depends on the active participation of students. Therefore, Ernest explained that mathematics games can strengthen and train skills, motivate, help the acquisition and development of mathematical concepts, and help students develop strategies for solving mathematical problems. Through this mathematical game activity, in the learning process, students not only learn independently, but also through social interactions that take place together [7].

Initial observations of student activities at the research location showed that almost 30% of grade VIII students at SMPN 1 Bulawa were less interested or not interested in learning mathematics, especially in materials that require visualization. Students' interest in reading textbooks is still lacking, because the presentation of textbooks is not interesting to read. Likewise, based on the results of interviews with math teachers, information was obtained that the teaching materials available at the school were still less than optimal in facilitating students to learn actively because the narrative in the teaching materials was predominantly textual. Questions and exercises in the teaching materials were presented in a normative manner so they were not very interesting for students to work on the questions and exercises. The presentation of the learning also seemed conventional, teachers had not presented fun learning, for example through a learning situation while playing. Even though the school has a wifi network facility, it has not been optimized for learning activities in the classroom, especially to present interactive media.

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The entertainment side in the context of learning while playing can inspire students to learn and improve their understanding of the concepts in the game. In the mathematics learning process, the use of media and mathematical games is often ignored, or even considered a waste of time. However, if we look closely, mathematics games are designed in detail to help develop intellectual intelligence, improve varied skills, especially problem solving, material transfer, and also provide understanding in the mathematics learning process [8]. The advantages of game-based learning in general are that it includes an emphasis on actions or actions rather than verbal explanations, generates motivation and personal satisfaction, is interactive, and improves decision-making skills [9]. Therefore, researchers are interested in developing crossword games.

Crossword can help students maximize their potential when learning mathematics, making them more creative and active. Crossword games are very effective because they can increase their critical thinking skills and mathematics learning outcomes [9]. Crossword games motivate and make students enthusiastic in learning vocabulary, making it easier for them to understand the material. Crosswords also stimulate reasoning and knowledge, and make learning memorable and unforgettable. This is because crossword games can foster students' enthusiasm and provide a challenge for them to solve a problem.

Crossword games is a game that uses the technique of filling empty spaces in a box with a row of letters whose equivalents have been adapted to the questions or instructions that have been given to us. These clues are usually grouped into categories, which are horizontal and descending, based on the position of the word that must be completed, and one of the goals of crossword games is to learn and improve the understanding we have so that it can be included in the answers that have been provided through questions. -questions in row or column form [10]. Crossword games have a positive impact on students by encouraging them to work together and find the correct answer, thus leading to healthy competition. Apart from that, the level of accuracy and accuracy is very important in finding the right answer in a crossword games, because the letters of the answer can influence the results of other answers in the row or column.

The crossword game in this e-module aims to stimulate proactive students so they can participate in the learning process comfortably and happily. Learning through this game provides a playing experience adapted to a more flexible and fun learning method to arouse students' interest in learning [11].

As a consider that the obstacles to teaching and learning that take place at SMP Negeri 1 Bulawa are still not using learning media which will have an impact on students' lack of understanding regarding learning material which is specific to flat-sided building materials, the presence of media is needed to support the learning process. Therefore, this research intends to develop a "Gaull" (Game Edukasi Wordwall) mathematics learning e-module by utilizing crossword games specifically aimed at valid and practical flat-sided geometric shapes.

METHODS

This research was conducted at SMP Negeri 1 Bulawa on 27 students of class VIII. The development procedure applied is a 4D development model (four D model) by Thiagrajan, Sammel and Semmel (1974). The stages of this 4D development model consist of four steps, which define, design, develop and then disseminate [12].

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This assessment sheet is given to experts or validators to provide suggestions and input regarding the preparation of teaching materials. The purpose of this validation is to obtain valid learning e-modul. Meanwhile, the data collection technique used focuses on the use of questionnaires, which by giving questionnaires to students and teachers after completing the learning process.

The validation questionnaire in this development research focuses on the Likert scale [13] which is described in the following table:

Table 1. Likert Scale Assessment

Score	Criteria
4	Very Good
3	Good
2	Fair
1	Poor

To measure the validity of material and media, use the formula:

$$\text{Level of validity} = \frac{\sum score\ obtained}{\sum maximum\ score}\ 100\%$$

Data obtained from the assessment will be converted using the following criteria [14]:

Table 2. Validity Criteria

Interval Score	Category
$\bar{x} > 3{,}40$	Very Valid
$2{,}80 < \bar{x} \leq 3{,}40$	Valid
$2{,}20 < \bar{x} \leq 2{,}80$	Somewhat Valid
$1{,}60 < \bar{x} \leq 2{,}20$	Not Valid

To revise each media component that has been created, data is used in the form of comments/suggestions from validators. The e-module developed can be said to be feasible at least with a score of $\geq 2{,}80$ and the media and material validator states that the learning media is feasible to produce with revisions.

Next, from the student respondent data questionnaire to the teacher response questionnaire to examine the practicality of the media used, the data generated from the teacher and student response questionnaires were converted to a liket scale and obtained using the following formula:

$$\text{Practicality} = \frac{\sum score\ obtained}{\sum maximum\ score}\ 100\%$$

To determine the level of practicality of a product being developed, the following assessment criteria are used [15]:

Table 3. Practicality Criteria

Achievement (%)	Category
$90\% - 100\%$	Very practical
$80\% - 89\%$	Practical
$65\% - 79\%$	Quite Practical
$55\% - 65\%$	Less practical
$0 - 54\%$	Not practical

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E-module development in research is categorized as practical if the results of the analysis of teacher and student responses show minimal presentation $\geq 80\ \%$.

RESULTS AND DISCUSSION

This development research has a 4D development model using the following stages.

a. *Define*

Intial-final analysis

This analysis is to determine and determine the validity of the problems to be faced. The initial and final analysis found a basic problem that existed at the research site where there was still a lack of teaching materials that were integrated with technology. Apart from that, the lack of application of learning using games in mathematics subjects is also the basic thing behind this research problem, so researchers hypothesize that they need to create novelty in more effective teaching materials to maximize time and support students' interest in learning mathematics and better understanding. mathematics material. On this basis, researchers took the initiative to develop teaching materials in the e-module model that can assist teachers in carrying out learning, especially the subject matter which includes Flat-side Space Buildings.

Students Analysis

Students at SMP Negeri 1 Bulawa have varying abilities and the lack of student enthusiasm in learning mathematics occurs especially in Flat-side Space Buildings. Judging from the learning support facilities, students' academic abilities have never utilized the teaching materials that have been developed, which makes students tend to be passive. This can be seen when the teacher explains the lack of proactive students in the classroom, which is illustrated by only playing with their classmates. In the learning process there are still some people who are less involved in the learning process, whether in discussions, able to provide feedback when the teacher asks questions and exchange information with friends. Based on the conditions of these students, the researcher will develop a "Gaull" mathematics learning e-module using crossword puzzle games as an intermediary for mathematics learning.

Task Analysis and Concept Analysis

Material or concept analysis is aimed at identifying, describing and arranging the material that will be taught to students systematically, which building a Flat-side Space Buildings. The material refers to the 2013 curriculum for class VIII SMP.

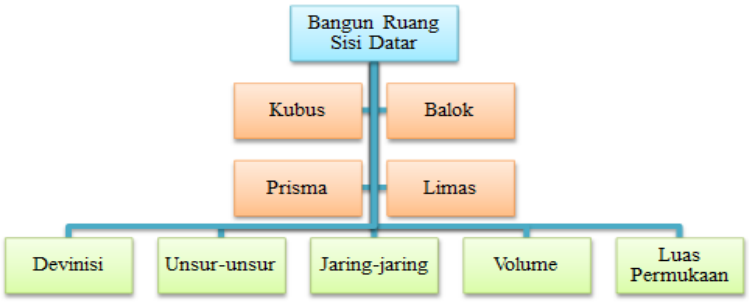

Figure 1. Concept Map of Flat-Side Space Building Materials

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Task Analysis

Based on the results of the analysis of the material on flat-side space building, the tasks that will be carried out by students during the learning process are identified as follows:

1) Defining flat-side space building
2) Finding flat-side space building formulas
3) Calculating the volume and surface area of flat-side space building
4) Solving problems related to flat-side space building

Formulation of Learning Objectives

The formulation of learning targets is explained through the results of descriptions of assignments that will be carried out by students as well as the results of curriculum elaborations focused on Core Competencies, Basic Competencies, then Indicators of Competency Achievement in flat-sided space building material.

b. Design

Format Selection

At this stage, the e-module design is prepared. This activity includes selecting a format for designing e-module content from learning resources used in e-module development. The e-module being developed is broken down into three main parts: the beginning, the contents, then the end. The initial part refers to the cover of the material and the author's editorial, foreword, and table of contents. The contents section includes the contents of the teaching materials contained in several activities and the final section is the bibliography. The results of the design that have been made are as follows:

a. Initial Part

a) Cover Page

Figure 2. Cover of E-Module

This picture shows the home page or cover for the e-module. On this page there is also a class identity and also a material identity.

b) Foreword page

In this display the foreword that has been made by the researcher. Which contains a narrative as an introduction to the e-module.

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c) Table of contents page

This picture shows a table of contents page designed as a guide to make it easier for readers to view the desired material.

Figure 3. Table of Contents Page

d) Instructions for use page

This picture shows that this page contains a sequence or mechanism on how to use the "Gaull" learning e-module.

e) Competency & Indicators Page

Figure 4. Competency & Indicator Page

This picture shows a page containing competencies and indicators to help students understand what knowledge, attitudes, and skills they can achieve after completing the lesson.

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f) Concept Map Page

Figure 5. Learning activity page

b. Contents Section

a.) Introduction page/overview of material

This picture shows an introductory section that introduces the topic to be covered, provides an overview of the learning objectives, and relates them to relevant context.

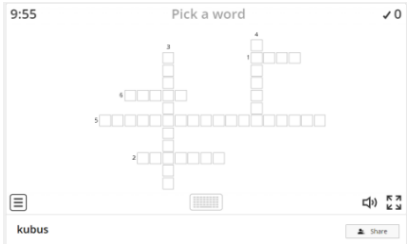
Figure 6. Introduction page

b.) Material Description Page

The material description is to explain in detail the learning material explained in the e-module.

c.) Assignment

This picture shows the Assignment or practice questions page created as a means for teachers to measure students' understanding of the material in the e-module that has been studied.



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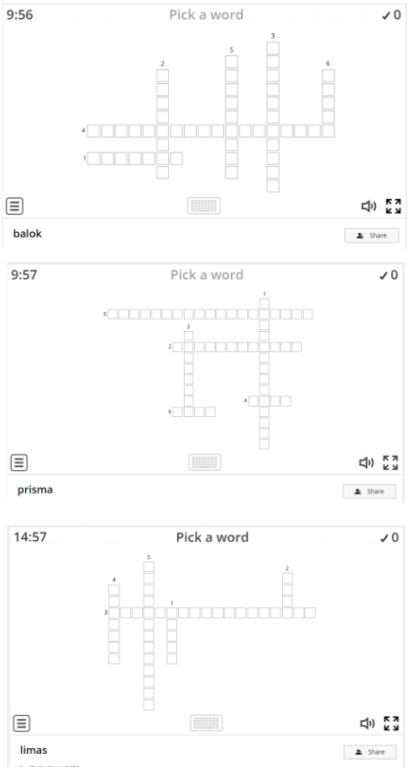

Figure 7. Assignment Page

d.) Summary

This picture shows the Summary section discussing the main topics.

Figure 8. Summary page

c. Final Part

a.) *Glossary*

This picture shows the Glossary section containing definitions of concepts discussed in the e-module and formulated briefly to remind students of the concepts that have been studied..

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Figure 9. Glossary page

b.) Final Test

This picture shows the Final Test section is exercises that students can complete after thoroughly understanding a section of the e-module.

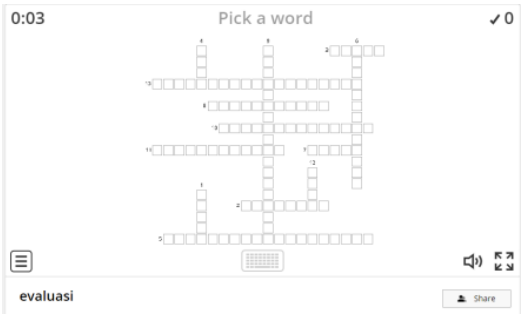

Figure 10 Evaluation Page

c.) Bibliography

This picture shows the library section containing references to books or sources that support and help compile the e-module.

Figure 11. Bibliography page

c. Development

In the development stage, the activities carried out are the development of learning media, assessment of media by experts, and revision of learning media. In this phase, at the start of creating the E-Module, it is prepared in MS Word and Canva as an initial file which will be conferred to Heyzine to then become a E-Module website. The crossword game in this e-

Print ISSN: 2580-3573, Online ISSN: 2580-2437

module is designed to encourage student activity and create a fun learning atmosphere. The use of games in learning aims to give the impression of playing and having fun, [11].

The results of the validation test and practicality test at the stage of developing the "Gaull" e-module design are as follows

Validation Test Results

The validation test is carried out in two stages, where there is a material validator test and a media validator test. The media validation test consisted of three lecturers and material validation consisted of 2 lecturers and 1 teacher. Likewise, the e-module has met material validity and media validity and is suitable for use after making minor revisions and improvements according to suggestions from the validator, with material validation getting a composition feasibility aspect score of 4 (very valid), content feasibility aspect of 3.62 (very valid), and the implementation aspect is 3.55 (very valid). So the total average for material expert validation is 3.72 with very valid criteria. And media validation received a score for the visual appearance aspect of 3.33 (valid), the sound aspect of 4 (very valid), and the ease of use aspect of 3.33 (valid). So the total average for material expert validation is 3.55 with very valid criteria.

Practicality Test Results

The practicality test was carried out in two stages, where there was a trial of teacher responses and a limited trial of student responses. Likewise, the e-module meets practicality and is suitable for use after making minor revisions and improvements according to suggestions from respondents. with teacher responses getting a practicality percentage of 97% covering very practical criteria and student responses getting a practicality percentage of 93.57% with very practical criteria.

d. Disseminate (Penyebaran)

This stage is the final phase of the 4-D development model. This dissemination was carried out on a limited basis, where teaching materials in the form of e-modules were distributed to mathematics teachers and students at SMPN 1 Bulawa.

The development of teaching materials in the form of e-modules is carried out using the 4-D (four-D) development model by Silvasailam Thiagarajan, Dorothy S. Semmel, and Melyn I Semmel 4-D Model to develop various types of learning media [16]. In the 4-D development model, the stages are arranged in a programmed manner, simple, easy to understand and more systematic implementation, Thiagarajan [17]. The purpose of this study is to validate and develop E-Modules into a product that can facilitate and increase students' interest in learning in the learning process on flat-side space building material.

This e-module is designed to deliver flat-side space building material using a crossword game that has an interesting appearance, design, and material concept. This e-module is also designed to make it easier for teachers to carry out the learning process, where this e-module is a guide for students and teachers to explain without students taking notes on what the teacher explains in front of the class, so that students focus on what the teacher explains. In this context, the teacher as a learning facilitator [18], [19]. Through the use of media, teachers can

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facilitate students' learning needs. Because the existence of media aims to increase the effectiveness and efficiency of learning [11].

At the definition stage, initial observations were carried out by interviewing teachers with the aim of analyzing the curriculum, students, and learning materials. In determining learning needs, things that need to be considered are the suitability of needs to the applicable curriculum, the development stage of students, school conditions, and problems in the field, Thiagarajan [17]. At this stage, researchers conducted direct interviews with subject teachers at the school to find out information about the obstacles experienced by students during the learning process, which then became the starting point for researchers to take appropriate action to overcome these obstacles.

The design stage is intended to determine the design to be used, which by selecting the initial design format of the e-module content [12]. This e-module design was created using Canva and Microsoft Word 2010 Software. The e-module format consists of three parts, which are the beginning, the content and the end. The beginning includes the cover, foreword, table of contents, instructions for using the e-module, competencies & indicators, and concept maps. The content section includes an introduction/general review of the material, description of the material, assignments, and a summary. The final section is the glossary, evaluation, and bibliography [20].

At the development stage, the e-module that has been created is validated by design experts and material experts [21], which are 3 validators each. For the e-module design experts were validated by 3 lecturers, and for the material experts, were validated by 2 lecturers and math teacher grade VIII at SMPN 1 Bulawa. After being validated and analyzed by media experts, a validity score of 3.55 was obtained for the validity of the e-module media with a very valid category and 3.72 for the validity of the e-module material with a very valid category. The validator concluded that this e-module was worthy of being tested with minor revisions. so that an e-module is obtained that truly meets the criteria for improving the resulting [22].

At the trial stage, the e-module was tested to determine the students' responses to the developed product so it could provide an assessment of the developed product, Benovri (2018). From the results of the student response questionnaire analysis, it showed a practicality percentage of 93.57% with a very practical category. Furthermore, the results of the teacher assessment questionnaire analysis of this e-module showed a practicality percentage of 97% with a very practical category and were said to be very good to implement in learning. The crossword game in this e-module is intended to encourage active students and teaching and learning activities in a pleasant atmosphere, therefore learning using games will give the impression of playing and having fun [11]. Thus can be said that this e-module is good and suitable for use in the mathematics learning process, especially in the material of flat-side space building because it meets the criteria for validity and practicality. The validity and practicality of the developed product are important aspects that must be met in developing a product as stated by [23]. Based on the practicality criteria obtained, it shows that this e-module helps increase students' learning motivation in learning mathematics with the presence of an e-module display that attracts students' attention and the presentation of practice questions and evaluations using crossword game that trigger students' curiosity, these results are in line with research by [18] that the use of

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crossword game media shows results that are able to form students' critical thinking in learning. cal thinking in learning. Student responses to the e-module "Gaull" using this crossword puzzle game, stimulate students to be active and enthusiastic in learning activities because it is presented interactively. This is in line with the research of [24]. Of course, this is expected to improve their ability to solve mathematical problems [25]. Therefore, teachers should always innovate in preparing learning resources for students by utilizing various learning media.

CONCLUSION

The results of the analysis of research data show that an E-Module for learning gaull mathematics on Flat-side Space Buildings has been produced and developed using crossword games as learning support material. Based on the results of the research and discussion, it can be concluded that the development of teaching materials with an e-module model on Flat-side Space Buildings for class VIII SMP/MTs using the 4-D (four-D) development model is valid and suitable for use as a teaching resource created for increasing students' interest in learning about Flat-side Space Buildings. This teaching material in the form of an e-module was rated as very valid and suitable for use because it had gone through the validation stage from 6 validators where the average assessment score from media expert validators was 3.55 and the average assessment score from material expert validators was 3.72. This teaching material in the form of an e-module has been assessed as practical and positive for use in mathematics learning because it has gone through the testing phase of teacher and student responses in the very practical category with percentages of 97% and 93.57% respectively.

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Print ISSN: 2580-3573, Online ISSN: 2580-2437