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Developing Student Worksheet Assisted with Geogebra on Derivative Materials

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Abstract. This study aims to determine the feasibility and attractiveness of students' responses to the development of learning media in the form of student worksheets assisted with GeoGebra on the derivative material. This research was conducted using the Research & Development (R & D) method through the development procedure proposed by Thiagarajan Sivasailam, which includes; 1). Define stage, 2). Design stage 3). Development stage, and 4). Dissemination stage. Data collection techniques used were validation questionnaire sheet. The instruments used were in the form of validation questionnaires to determine the feasibility of the student worksheets and questionnaire responses of students to find out the attractiveness. The data analysis technique used in research and development was quantitative descriptive to process the data in the form of scores from the evaluations by the validators and responses from the students. The qualitative descriptive was used to describe the data in the form of comments suggesting improvements from the validators. The results of student worksheets validation from material experts obtained an average value of 4.60 with very valid criteria. The results of student worksheets validation from media experts obtained an average value of 4.00 with valid criteria. The students' responses toward the developed learning media in small-group trials obtained an average value of 3.70 with attractive criteria and in the large-group trials obtained an average value of 3.75 with attractive criteria. This means that the learning media in the form of student worksheet assisted with GeoGebra in the derivative material is feasible and attractive.

1. Introduction

Education is a measure of the progress of a nation. It has the main role to produce a good and quality human resource [1]. Education is important in improving the quality of human resources so that efforts need to be made to improve the quality of education services [2]. Education affects the development of science which must be balanced with adequate technological capabilities to bring change to the world of education today. The existence of developing technology has a very large influence on the quality of education [3]. The educational process cannot be separated from the learning process. Learning is essentially a combination of teaching activities carried out by teachers and students so that behavioral changes could occur in a better direction [4-5]. There are several components that must be completed in the learning process. Learning media is one component of learning that has an important role in teaching and learning activities [6-7]. Learning media is very diverse in forms including the tools used physically to convey the contents of teaching materials consisting of books, software, and hardware such as computers, TVs, OHPs, videotapes, books, films, transparency models and others [8]. But the fact is that good learning media have not been used so much and are still limited due to expensive costs. The limited learning media developed to support teaching and learning activities causes learning to be less optimal, so students are less enthusiastic and interested in receiving the material, and understanding of basic material eventually becomes limited [9]. Even the absence of learning media can inhibit the



learning process [10]. As for the media that are not yet fully understood by students, many students are still having difficulty in understanding the material, especially in the derivative material. This becomes a problem, it is necessary to develop learning media that mediate the interaction between teachers and students in the form of teaching materials in the form of student worksheets in order to facilitate students in understanding the material at a low cost. The world of computer technology that is currently developing is opening up vast opportunities for teachers to be able to make good use of it [8]. One of the fields in learning technology is creating appropriate teaching materials according to the needs [11]. The teaching material in question is learning media in the form of student worksheets assisted by GeoGebra.

Learning media is a tool in visualizing abstract material into concrete as well as to overcome the limitations of the experience possessed by students during the learning process [6–9, 12]. One of the learning media is student worksheets [13]. Student worksheets is a media for students containing a series of activities used in conducting investigative activities to optimize the involvement of activities in learning with the aim of activating the role of learners [13–15]. The use of computers as learning media is known as computer-assisted teaching. Computer-assisted learning is learning that functions through software. Computer-assisted learning with applications software assisted by GeoGebra is a new concept that until now many types of design and implementation can be utilized in the teaching and learning process [16]. There are several softwares in mathematics, especially in the field of geometry, one of which is GeoGebra. Geogebra is a computer program that is also able to explore a variety of geometric shapes from simple to complex to help the students understand learning material [17]. As for some of the results of previous research on the development of the student worksheets with a decent development media obtained, including the development of student worksheets ; reading-based method using circ with interactive CD, entrepreneurial oriented, based on realistic mathematics education, oriented to Islamic religious values through a guided inquiry approach, process-based skills based on a specific approach, and student worksheets with Thiagarajan development model [18–24]. Previous research also used the same GeoGebra with effective results including; the development of learning devices in the form of syllabus, lesson plans, and student worksheets produced with very valid criteria, learning model of Think-Talk-Write (TTW) strategy can achieve learning completeness, learning Cycle 5E with GeoGebra application is better than conventional learning-assisted geometry, and the application of Geogebra-assisted problem-based learning can increase motivation and learning achievement in mathematics [17, 5–28].

As for the existing research and development, in this study, the development of an up-to-date learning media was developed in the form of student worksheets assisted by GeoGebra software in the derivative material. Research and development were carried out to determine the feasibility and attractiveness based on students' responses toward the development of learning media so that it can produce appropriate and attractive student worksheets learning media to be used in the learning process.

6 Research Methods

The type of research in this development is Research and Development [29]. This research was conducted using the Research & Development (R & D) through the 4D development procedure proposed by Thiagarajan Sivasailam, which include 1). Define stage, 2). Design stage 3). Development stage, and 4). Dissemination stage. There were two types of data used, namely qualitative data and quantitative data. Data collection techniques used were validation questionnaire sheet. The instruments used were in the form of validation questionnaires to determine the feasibility and questionnaire responses from students to find out the attractiveness. Data analysis techniques used were quantitative descriptive to process data in the form of scores from the assessment of material expert validation and media experts as well as student responses, while qualitative descriptive was used to describe the data in the form of comments suggesting improvements from the validator. As for the steps of research and development carried out by the researchers, the results of the modification were based on Thiagarajan, Semmel, and Semmel (in Trianto, 2011: 94) can be seen in Figure 1 [23].

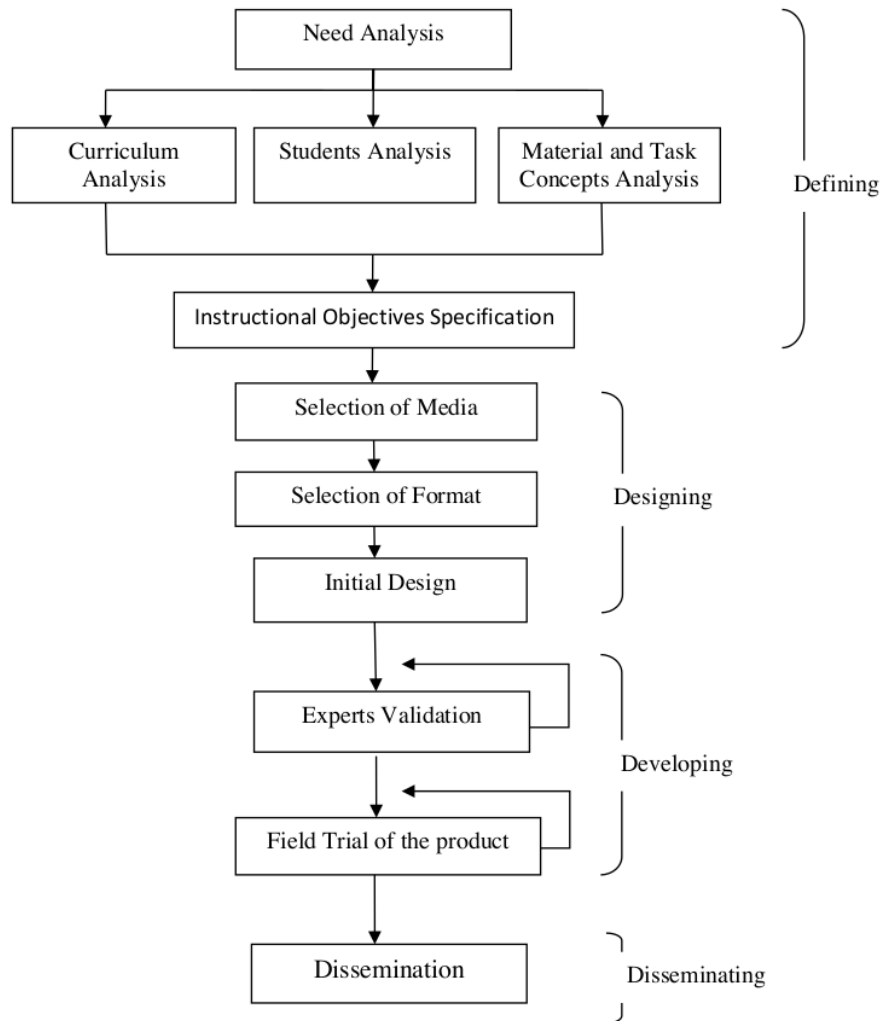


Figure 1 Research and Development Procedure

The assessment of the student worksheets by the validators on the validation questionnaire ¹⁸ is based on the Likert scale which has gradations from very positive to very negative, which can be in the form of Strongly ²⁶ agree (SS), Agree (ST), Doubtful (RG), Disagree (TS), and Strongly Disagree (STS) [30]. The Likert scale was used by giving a score ⁵ (5, 4, 3, 2, 1) in the form of a checklist [30]. Guidelines for scoring the questionnaire validation sheet can be seen in Table 1.

Table 1. Scoring Guidelines for Assessment ²⁵ [30]

Choice of answers	scores
Strongly agree (SS)	5
Agree (ST)	4
Doubtful (RG)	3
Disagree (TS)	2
Strongly Disagree (STS)	1

Then the calculation of each question uses the following formula::

$$\bar{V} = \frac{\sum_{i=1}^n x_i}{n}$$

Keterangan:

\bar{V} = Average total validity

x_i = Score aspect-i

n = Number of aspects

The final step was to conclude the calculation results based on range percentages and criteria as can be seen in Table 2.

Table 2. Range Percentage and Student Worksheets Criteria [23]

Interval Skor	Kategori
$0 \leq \bar{x} < 1,8$	Not Feasible / Not Attractive
$1,8 \leq \bar{x} < 2,6$	Less Feasible / Less Attractive
$2,6 \leq \bar{x} < 3,4$	Fairly Feasible / Fairly Attractive
$3,4 \leq \bar{x} < 4,2$	Feasible / Attractive
$4,2 \leq \bar{x} \leq 5$	Highly Feasible/ HighlyVery Attractive

The product of development will end when the assessment score has fulfilled the eligibility requirements with the level of material suitability and design.

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3. Results And Discussion

The results of the research and development carried out by the researcher were to produce learning media for students in the form of worksheets assisted by GeoGebra software in the derivative material. Research and development were done using 4D development procedures. Data from each stage of the procedure is described as follows:

1) Define Stage

The define stage usually called the needs analysis. This stage includes several steps including:

a. Curriculum Analysis

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Curriculum analysis was carried out by analyzing core competencies, basic competencies, and indicators of competency achievement by referring to the 2013 curriculum. The results of curriculum analysis were the application of competency standards, basic competencies, and indicators of competency achievement in derivative material for the students of the eleventh grade of Vocational High School (SMK).

b. Students Analysis

Students analysis studied the characteristics of students and to find out the needs of students for the developed products. The first step was to collect problems in the field. Generally, students have difficulty in solving problems about the derivative material, limited learning media, and there were no learning media in the form of student worksheets assisted by GeoGebra software.

c. Analysis of Material and Tasks Concepts

In analyzing this material concept, it can be seen from the core competencies, basic competencies, and indicators which will later be obtained the main concepts related to the derivative material. All concepts would be explained simply and easily so that the students could remember and understand. Task analysis was done by identifying the main material that needs to be taught, collecting, and selecting relevant material.

d. Instructional Objectives Specification

Based on the results of curriculum analysis, characteristics of students, material concepts and assignments, the learning objectives to be achieved could be determined

2) Design

This design aims to design learning media to obtain the initial draft. The developed learning media is in the form of student worksheets assisted by GeoGebra in the derivative material. Steps for preparing product design were based on the 2013 curriculum.

a. Selection of Media

The selected learning media was in the form of student worksheets using Microsoft Word 2017. The student worksheets were developed using Geogebra application. The cover was designed using Corel Draw X4.

b. Selection of Format

Preparation of student worksheets in accordance with the sub-chapter of material using B5 paper size; scale spacing of 1.5, and the font used was Times New Roman. The student worksheets were equipped with drawings, examples, graphs, and tables that support the content of the material. To display the images clearly, the GeoGebra application was used.

c. Initial Design

Designing the product based on the final result of the initial product. The initial design of the student worksheets product development consisted of the front and back cover, the module development team page, preface, and the table of contents. The development of the student worksheets was structured as the general worksheet.

3) Develop

At this stage, the initial product that has been completed at the stage design would be developed.

a. Expert Appraisal

Assessment by the experts was conducted by a material expert and a media expert. Validation test to assess the feasibility of the developed learning was assessed by 3 validators including 2 material experts and 1 media expert. The material experts validated 3 aspects, namely the active aspects, the construction aspects, and the technical aspects. The media expert analyzed based on the assessment of 3 aspects, namely aspects of size, aspects of cover design, and design of the contents of the student worksheets. After the validation by the experts was done, the next step was the revision. After that, a product trial was carried out to students.

Validation

1. The Result of Material Expert Validation

The results of material expert validation on the developed learning media can be seen in Figure 2.

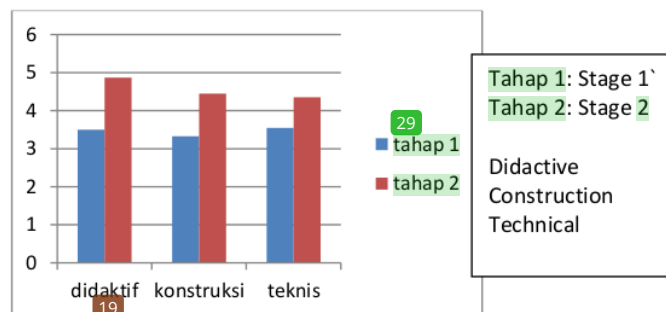


Figure 2 Results of Material Expert Validation

Based on Figure 2, it was known that the results of the material expert assessment in stage 1 and stage 2 are as follow: in the didactic aspects in stage 1, the average score obtained was 3.50 with the feasible criteria. The construction aspect obtained an average score of 3.33 with the quite feasible criteria. The technical aspect obtained an average score of 3, 55 with the feasible criteria. In stage 2,

the average score on the didactic aspect was 4.87 with the highly feasible criteria. The construction aspect was 4.45 with the highly feasible criteria. The technical aspect was 4.35 with the highly feasible criteria. Based on the explanation above, there is an increase in each aspect validated by the material experts. The following is a sample from the display based on the results of the material expert validation in stage 1 before the revision and stage 2 after the revision:

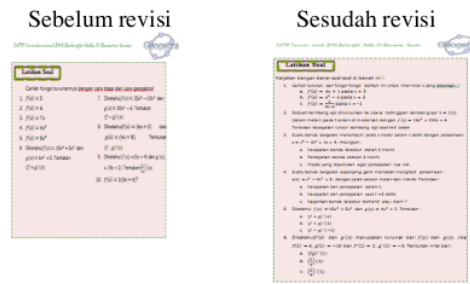


Figure 3 Tambahn Soal Pada Latihan Soal

1. Results of Media Expert Validation

The results of media expert validation can be seen in figure 4

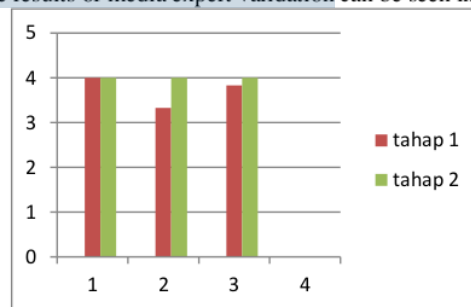


Figure 4. Results of Media Expert Validation

Based on Figure 4, it is known that the results of the media expert validation assessment increased in the validation of stage 2. The score for aspect number 1 in stage 1 has an average score of 4.00 with the highly feasible criteria. The aspect number 2 obtained an average score of 3.33 with the quite feasible criteria. The aspect number 3 obtained an average score of 3.83 with feasible criteria. In the second stage, the average score of aspect number 1 was 4.00 with the highly feasible criteria. The aspect number 2 obtained an average score of 4.00 with the feasible criteria. The aspect number 3 obtained an average score of 4.00 with the feasible criteria. It can be seen from figure 4 that the results of validation between stage 1 and stage 2 experienced a fairly good increase and was included in the feasible criteria even though number 1 did not increase because it had reached very feasible criteria in stage 1. It can be concluded that the developed product was already feasible and ready to be used in small-group trials and large-group trials.

Revision

After the product design was validated through the assessment of material experts and media expert, then the researchers revised the product design based on input from the experts.

b. Developmental Testing ¹⁵

Developmental testing (trial) was conducted to the target group of students to assess the learning media. The results ¹² the trials were related to the attractiveness of the product were carried out in two stages, namely the small-group trial and large-group trial.

Students' Responses toward the Product's Trial

The results of the trial related to the attractiveness based on small-group trial ¹⁰ can be seen in Table 3.

Table 3 The Result of Small-Group Trial

Respondents	Total Score	Feasibility Score	Criteria
1	75	3.75	Attractive
2	73	3.65	Attractive
3	73	3.65	Attractive
4	83	4.15	Highly Attractive
5	74	3.7	Attractive
6	70	3.5	Attractive
7	80	4	Attractive
8	66	3,3	Quite Attractive
9	84	4.2	Highly Attractive
Number	678	33.9	$\bar{x} = 3.9$

The average score obtained ¹³ 3.9 with the attractive criteria in the small-group trial. The result of the large-group trial can be seen in Table 4.

Table 4 The Result of Large-Group Trial

Respondents	Total Score	Feasibility Score	Criteria
1	60	3	Quite Attractive ¹⁴
2	78	3.9	Attractive
3	75	3.75	Attractive
4	60	3	Quite Attractive
5	67	3.35	Attractive
6	88	4.4	Highly Attractive
7	73	3,65	Attractive
8	76	3.8	Attractive
9	73	3.65	Attractive
10	91	4.55	Highly Attractive
11	87	4.35	Highly Attractive
12	80	4	Attractive
13	70	3.5	Attractive
14	72	3.6	Attractive
15	72	3.6	Attractive
16	82	4.1	Attractive
17	70	3.5	Attractive
18	78	3.9	Attractive
19	71	3.55	Attractive
20	78	3.9	Attractive
21	79	3.95	Attractive

Respondents	Total Score	Feasibility Score	Criteria
22	64	3.2	Attractive
23	88	4.4	Highly Attractive
24	74	3.7	Attractive
25	78	3.9	Attractive
26	71	3.55	Attractive
27	85	4.25	Highly Attractive
28	85	4.25	Highly Attractive
29	56	2.8	Quite Attractive
30	64	3.2	Attractive
31	85	4.25	Highly Attractive
Total	2,325	116.5	$\bar{x} = 3.75$

In table 4, the average score is 3.75 with the attractive criteria in the large-group trial. This means that the developed learning media are feasible and attractive.

4) Dissemination

This stage was carried out by researchers through limited distribution due to the needs of the researchers. Researchers disseminate this learning media product only at Bandar Lampung Vocational High School 7 as the site of the research.

Previous research and development obtained proper and effective student worksheets, likewise, the results of this research and development in the form of student worksheets assisted by Geogebra software in derivative material also obtained a feasible and attractive result. The difference of this product and the previous ones is that the application Geogebra software that has not been applied in previous studies.

4. Conclusion And Suggestion

The results of validation and trials toward the student worksheets assisted by Geogebra software on derivative material produced a feasible and attractive product. This research and development still require follow-up to the stage of dissemination and implementation of the final product to test the effectiveness of the product and to know its influence on improving the quality of learning so that the product can be used in learning. Hopefully, this research can be useful and become reference sources for further research and can be published widely.

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