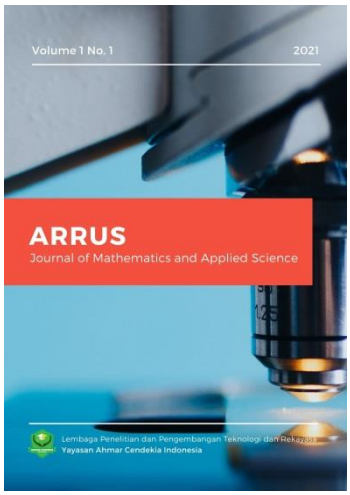
https://doi.org/10.35877/mathscience617

OPEN ACCESS

ISSN : 2776-7922 (Print) / 2807-3037 (Online)



RESEARCH ARTICLE

The development of digital teaching materials using Macromedia flash for Junior High School class VII

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Abstract: This research aims to develop and produce digital teaching materials products using Macromedia flash application that are valid, practical and effective. This research method refers to a 4D development, and disseminate. Research instruments in the form of validation sheets by material expert and media expert to measure validity; questionnaires of learners; responses to measure practicality; and test of learning outcomes to measure effectiveness. The trial of teaching materials was conducted to class VII learners at SMPN 6 Makassar. The result showed that digital teaching materials developed using Macromedia flash applications in class VII junior high school comparison materials had valid criteria with validity score of 3.70 for the material and 3.50 for media, practically score of 3.60 for small groups and 3.51 for large groups, and effective with an effectiveness score of 90% for small groups and 86% for large groups.

Keywords: Development, Valid, Practical, Effective

1. Introduction

The world today has entered the digital era where all the information needed by humans can be conveyed quickly and easily. This is due to the ease of accessing the internet so that humans freely get the various information needed quickly (Hakim & Mulyapradana, 2020). Human life in the 21st century is increasingly advanced with supporting technology and science. In this development, it is required to achieve a young generation who has high competitiveness in order to adapt to the times. One of the skills in the 21st century is learning with innovative abilities, both in terms of delivery and from the learning media used (Wahyuni, 2020).

The use of computers and the internet has proliferated not only in the office but also in schools. This change is a marker of changes that occur in schools, technology has penetrated the world of education, both for educators and students (Nasrullah & Baharman, 2017). Educators are required to be able to adapt in utilizing technology and be able to teach online and students are also required to be able to use technology so that they can participate in online learning.

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The use of computers and the internet has proliferated not only in the office but also in schools. This change is a marker of changes that occur in schools, technology has penetrated the world of education, both for educators and students (Nasrullah & Baharman, 2017). Educators are required to be able to adapt in utilizing technology and be able to teach online and students are also required to be able to use technology so that they can participate in online learning.

In the world of education there are various lessons that must be learned by students, one of which is mathematics. Mathematics is one of the subjects studied at all levels of school. These subjects have the aim that students can understand mathematical concepts, explain the relationship between concepts and apply these concepts accurately and efficiently in problem solving (Ibrahim & Suparni, 2008). To achieve this goal, a teacher must have skills in choosing, using methods and carrying out new innovations in creating an effective and efficient learning environment for students. The use of good learning methods will affect the learning process in the classroom for the better so that students will be more enthusiastic in learning.

In the learning process, the presence of teaching materials has an important role because the ambiguity of the material presented can be helped by presenting teaching materials as intermediaries. The use of teaching materials also affects the effective allocation of time during the implementation of learning (Lasmiyati & Hatta, 2014). One way that can be done by teachers is to develop learning media in the form of teaching materials. The development of teaching materials in the learning process needs to be done, in order to create effective and efficient learning (Lukman & Ishartiwi, 2014).

So far, teaching materials or learning programs are not designed interactively or the learning management system does not offer sophisticated writing tools (Nasrullah & Bernard, 2015). Whereas teaching materials that should be developed are teaching materials that are packaged in digital form, namely teaching materials that combine material text with attractive images, audio and animation. The characteristics of such teaching materials can help students understand lessons, especially mathematics.

By using teaching materials with interactive components, it is expected to be able to achieve the goals that have been targeted in learning (Rahmawati & Hasanah, 2021). In order to create good and interesting learning, of course a teacher must continue to learn and increase creativity in designing creative and innovative learning. Therefore, the researcher intends to develop digital teaching materials, namely teaching materials that contain material text then combined with interesting images and animations using one of the animation design applications, namely Macromedia flash. The teaching materials were developed to meet the valid, practical and effective criteria so that they can be used as appropriate learning resources for learning mathematics, in this case the comparison material for class VII SMP.

2. Literature Review

According to Sumarno (2012), development is the process of translating design specifications into physical form, such as printing technology, audio-visual technology, computer-based technology and integrated technology. In addition, development can be interpreted as an effort that is carried out consciously, planned, directed to make or improve, so that it becomes a product that is increasingly useful for improving quality as an effort to create better quality. Specifically, development in this research means a process to produce and develop digital teaching materials on comparative materials.

In the education world, according to Borg and Gall (1983), research and development is research that is used to develop and validate educational products. The steps of the research development cycle are: first, studying the results of research related to what will be developed; second, develop products based on these findings; third, the test field in the setting that will be used eventually and revise it to correct the deficiencies found in the stage of submitting the test (Fahrurrozi & Mohzana, 2020).

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In general, there are three types of development models, namely: (1) procedural models; is a descriptive model, (2) a conceptual model; is an analytical model of the product components to be developed and the relationship between components, and (3) the theoretical model is a model that shows the relationship of changes between events (Fahrurrozi & Mohzana, 2020). Among the three types of development models, the model that is widely used in development research is the procedural model. The examples of procedural development models are the Kemp, Dick and Carry models, ADDIE models, ASSURE models, Hannafin and Peck models, Gagne and Briggs models, Borg and Gall models and 4D models.

The 4D model is the recommended model in the development of learning tools (Rizki & Linuhung, 2016). The 4D model proposed by Thiagarajan, Semmel and Semmel (1974), is a model for developing learning tools. This 4D model has a development cycle consisting of four stages of development, namely definition, design, development, and dissemination. The defining stages include front end analysis, student analysis, task analysis, concept analysis and formulation of learning objectives. The design stage consists of the preparation of tests, media selection, format selection and initial design. The development stage consists of expert assessment and limited trial. Then the dissemination stage consists of validation tests, packaging and adoption. The stages of development in the 4D model are focused on efforts to develop learning tools, not learning system models.

Teaching materials are a set of materials that are systematically arranged both written and unwritten so as to create an environment/atmosphere that allows students to learn. Educators must use teaching materials that are in accordance with the curriculum, target characteristics, and learning problem solving demands (Cahyono & Daryanto, 2014). Teaching materials have various types, namely printed teaching materials and non-printed teaching materials. Majid (2011) divides 4 types of teaching materials including printed teaching materials, audio teaching materials, audio-visual teaching materials and interactive teaching materials or interactive multimedia. While digital teaching materials are made using technological equipment such as computer software, laptops, and gadgets. In addition to being made digitally, digital teaching materials are also used or used by students and teachers digitally using gadgets, tablets, laptops, and computers.

Software is a physical abstraction that allows users to talk (interact) with hardware machines. Without software, the hardware that has been created will not be useful or function optimally (Maulana, 2017). Various kinds of software can be used in creating or using teaching materials or learning media such as Corel draw, Microsoft Powerpoint, Macromedia Flash, and others. One of the software that can be used as learning media is Macromedia Flash. Macromedia Flash is a program that can be used to create various kinds of animations, presentations, games and even teaching devices (Gora, 2005). The Macromedia Flash program has advantages when compared to other computer programs such as Microsoft Word or Microsoft Power Point, namely the ability to integrate materials that have been created using other computer programs so as to produce complete learning media (Holiwarni, 2014).

A teaching material meets the feasibility and quality if it meets three criteria, namely validity, practicality, and effectiveness (Nieveen, 1999). Valid means that it is in accordance with what it should be, so that it meets the conditions. Learning media is said to be valid if the media fulfills all aspects such as content and objectives, writing format, language, instructional and technical. Practical means that it can provide ease of use. The developed teaching material products make it easy for teachers and students to operate them and are in accordance with the objectives (Yamasari, 2010). Effective means that the results can achieve the goals and as expected. Teaching materials are said to be effective if the media can help students achieve the competencies they must have and achieve the objectives of the teaching materials.

Junior high school students are included in the formal operational stage of Piaget's cognitive development where students are introduced to and understand abstract ways of thinking. The progress of students in this period is that they do not need to think with the help of concrete objects, are able to understand the form of arguments and are no longer confused with other

ISSN : 2776-7922 (Print) / 2807-3037 (Online)

arguments (Ibda, 2015). Learning that emphasizes the learning process will be appropriate for junior high school students, because through learning that focuses on the learning process can make students more interested in teaching materials that display material that is often encountered in everyday life.

Comparative material is material that is taught in class VII SMP curriculum 2013. The composition of this material is in accordance with the electronic student book published by the Ministry of Education and Culture of the Republic of Indonesia where comparative material is the first material in the even semester (Indonesia, 2017). Comparison is a mathematical relationship between two or more values of a similar quantity and is expressed in a simple way. The ratio of a to b is expressed in the form a:b.

3. Research Method and Materials

The type of research that will be used is R & D (Research & Development) research, which is research oriented to researching, designing, producing, testing, the validity of the resulting product (Sugiyono, 2015). The research method used by the researcher is research on the development of 4D devices (four D models). The 4D development model is: Define, Design, Develop, Disseminate.

This research was conducted at one of the junior high schools in Makassar City, South Sulawesi. The subjects in this study were class VII students who were divided into 2 groups, namely small groups and large groups. For small groups consisting of 20 students and for large groups consisting of 50 students.

The research supporting instruments used in this study were the instrument of the validity of teaching materials in the form of a validation questionnaire by media experts and material experts, the instrument of practicality of teaching materials in the form of questionnaires for teacher and student responses related to the ease and benefits of teaching materials, as well as the effectiveness of teaching materials in the form of test of learning outcomes of comparative material and student response questionnaires related to pleasure, activity and attention. Each of these instruments was validated by two experts.

Data collection in this study started from the define stage, namely by conducting interviews with teachers and students as a preliminary study to find problems and obstacles that could be solved by making Macromedia flash-based digital teaching materials. After the data and information have been obtained, the next step is to enter the design stage. At this stage the teaching materials are designed starting from the selection of media, the selection of the format of the teaching materials to the making of the initial draft of the digital teaching materials that will be developed. After the draft of the teaching materials has been completed, then enter the develop stage. At this stage the draft teaching materials that have been designed are then validated by validators of media experts and material experts. After revision of teaching materials based on suggestions from the validator and teaching materials are declared valid, these digital teaching materials are ready to be tested. The trial was carried out on small groups and large groups. After the trial was carried out, teachers and students were given response questionnaires to see the practicality and also the effectiveness of digital teaching materials. In addition, students are also given a learning outcome test to see the level of students' understanding of comparative material. After going through a series of development stages and the digital teaching materials made are declared valid, then they enter the final stage, namely the disseminate stage. At this stage, the developed teaching materials are then distributed to educators and students. For the first step, these teaching materials were introduced at the research site which was attended by the principal, vice principal, teachers and also students.

4. Result and Discussion

4.1 Validity of teaching materials

https://doi.org/10.35877/mathscience617

ISSN : 2776-7922 (Print) / 2807-3037 (Online)

The assessment of the validity of digital teaching materials using the Macromedia flash application on comparison materials for class VII SMP was carried out by a media expert validator and a material expert validator. The material expert validator for this teaching material is a lecturer from the Mathematics Department of FMIPA UNM, he is a doctor in the field of mathematics education, teaches various mathematics education courses including learning media, has validated various research instruments related to mathematics education and has achievements in math field. The material expert validator for this teaching material is a lecturer from the Mathematics Department of FMIPA UNM, he is a doctor in the field of mathematics education, teaches various mathematics education courses including learning media, has validated various research instruments related to mathematics education and has achievements in math field. In this validity assessment carried out up to 2 stages with the results of teaching materials valid and feasible to be tested. The following are the results of stage 1 material validation:

Table 1: Results of material assessment by material and media experts stage 1

Validator	Aspek	Nilai validator	Kriteria
Material Expert	preliminary	3.25	Quite Valid
	Contents	3.20	Quite Valid
	language	3.42	Valid
	Closing	3.12	Quite Valid
	Whole	3.25	Quite Valid
Media Expert	Media Display	3.11	Quite Valid
	Use	3.12	Quite Valid
	Whole	3.12	Quite Valid

Based on table 1, it can be seen that for material expert validation the average score of each aspect is 3.25 for the preliminary aspect, 3.2 for the content aspect, 3.42 for the linguistic aspect and 3.12 for the closing aspect. As for the overall value of the validation of the material for stage 1 of this digital teaching material, which is an average of 3.25, it is in the range $2{,}51 < \bar{x} \leq 3{,}26$ so that it is a fairly valid criterion, which means that this teaching material must be partially revised in accordance with the suggestions of the validator. For media expert validation, it can be seen that from the two aspects assessed, both of them entered quite valid criteria with an average value of 3.11 for the media display aspect and 3.16 for the usage aspect, respectively. As for the overall value of the media validation stage 1 of this digital teaching material, which is an average of 3.125 in the range $2{,}51 < \bar{x} \leq 3{,}26$ so that it is a fairly valid criterion, which means that this teaching material must be partially revised in accordance with the suggestions of the validator.

Suggestions or inputs from material expert validators are then recorded by researchers and then these digital teaching materials are revised according to the suggestions given. After completing the revision of the digital teaching materials, they are then validated again by material experts and media experts for the second stage.

The next stage is the validation of the material phase 2 which is carried out by the material validator and media validator which is the same as the material validator and the phase 1 media validator. Phase 2 material validation is carried out to determine whether this digital teaching material is valid or not. The data from the validation of the material phase 2 can be seen in the following table.

Table 2: Hasil penilaian materi oleh ahli materi dan media tahap 2

Validator	Aspect	Validator value	Criteria
Material Expert	preliminary	3.25	Quite Valid

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ISSN : 2776-7922 (Print) / 2807-3037 (Online)

	Contents	3.20	Quite Valid
	language	3.42	Valid
	Closing	3.12	Quite Valid
	Whole	3.25	Quite Valid
Media Expert	Media Display	3.11	Quite Valid
	Use	3.12	Quite Valid
	Whole	3.12	Quite Valid

Based on table 2, it is obtained data that for material expert validation the four aspects assessed have entered the valid category with an average score of each aspect, namely 4 for the preliminary aspect, 3.6 for the content aspect, 3.85 for the linguistic aspect and 3.5 for the closing aspect. As for the overall value of the validation of the material for phase 2 of this digital teaching material, which is an average of 3.70, it is in the range $3{,}26 < \bar{x} \leq 4{,}00$ so that it enters the valid criteria, which means that the teaching material is feasible without revision and the teaching material is ready to be tested in terms of the material presented. For the validation of media experts, data obtained that the two aspects assessed were in the valid category with an average score of 3.44 for the media display aspect and 3.66 for the usage aspect, respectively. As for the overall value of the material validation phase 2 of this digital teaching material, which is an average of 3.50, it is in the range $3{,}26 < \bar{x} \leq 4{,}00$ so that it enters the valid criteria, which means that the teaching material is feasible without revision and the teaching material is ready to be tested in terms of the media presented.

4.2 Practicality of teaching materials

After the teaching materials are declared valid by the expert validators and deserve to be tested, the teaching materials are ready to be tested. This product was tested on 20 students of class VII.A for small groups and 50 students selected from class VII.A, VII.G, VII.H and VII.I for large groups. For class VII.A, students who have participated in the small group trial no longer participated in the large group trial.

The form of the trial of this teaching material is that the researcher first carries out learning using digital teaching materials that were developed for research subjects accompanied by a mathematics teacher. The learning process was carried out in 2 meetings. After carrying out the learning process for 2 meetings, then the teacher and students were given a response questionnaire to see the practicality of the material. The results are as follows.

Table 3: The results of the practicality response questionnaire assessment by teachers and students

Respondent	Aspect	Average score	Criteria
Teacher	Help	3.60	Practical
	Convenience	3.80	Practical
	Whole	3.70	Practical
Small Group Students	Help	3.50	Practical
	Convenience	3.70	Practical
	Whole	3.60	Practical
Large Group Students	Help	3.52	Practical
	Convenience	3.50	Practical
	Whole	3.51	Practical

Based on table 3, it is obtained data that for the teacher response questionnaire, the two aspects assessed have entered the practical category with an average score of 3.60 for the assistance aspect and 3.80 for the convenience aspect respectively. As for the overall value of the student response questionnaire to this digital teaching material, an average of 3.70 is in the range $3{,}26 < \bar{x} \leq 4{,}00$ so that it enters the practical criteria. for the small group student response questionnaire, the two aspects assessed were categorized as practical with an average score of 3.50 for the assistance aspect and 3.70 for the convenience aspect, respectively. As

https://doi.org/10.35877/mathscience617

ISSN : 2776-7922 (Print) / 2807-3037 (Online)

for the overall value of the student response questionnaire to this digital teaching material, an average of 3.60 is in the range $3{,}26 < \bar{x} \leq 4{,}00$ so that it enters the practical criteria. for the large group student response questionnaire, the two aspects assessed were categorized as practical with an average score of 3.52 for the assistance aspect and 3.50 for the convenience aspect, respectively. As for the overall value of the student response questionnaire to this digital teaching material, an average of 3.51 is in the range $3{,}26 < \bar{x} \leq 4{,}00$ so that it enters the practical criteria. Thus, the digital teaching materials developed are useful and easy to use by teachers and students.

4.3 Keefektifan Bahan ajar

The effectiveness of teaching materials can be measured by conducting tests of student learning outcomes and the achievement of the objectives of teaching materials. For the material in the questions made in this test, it represents the entire material in digital teaching materials with the main material being comparisons and sub-materials, namely ratios, scales, comparisons of value, inverse comparisons of values and presentation of comparisons in the form of tables, graphs and equations. The number of test questions given are 15 numbers consisting of 10 multiple choice questions and 5 filled-in questions with a maximum score of 100. The questions are given to small groups of 20 students and large groups of 50 students.

Table 4: Student learning test results for comparative material

Respondent	Average score	Percentage of completeness	Criteria
Small Group Students	83	90%	Effective
Large Group Students	82.4	86%	Effective

The value of the Minimum Completeness Criteria (KKM) for junior high school mathematics in Makassar is 80. Students are said to be complete if they get a score of ≥ 80. Based on table 5 above, it is found that the average test score for small group students' learning outcomes is 83 with the percentage of completeness that is 90% or 18 subjects were declared complete and the other 2 were declared incomplete. Based on the value of the percentage of completeness, this teaching material is in the range $85 < p \leq 100$ so that it enters the effective criteria. For the subject of large group students, it was found that the average test score for learning outcomes was 83 with a percentage of completeness that was 86% or 43 subjects were declared complete and 7 others were declared incomplete. Based on the value of the percentage of completeness, this teaching material is in the range $85 < p \leq 100$ so that it enters the effective criteria.

In addition to learning outcomes tests, students were also given a response questionnaire regarding the effectiveness of the developed digital teaching materials. The result can be seen in the following table.

Table 6: The results of the assessment of the effectiveness response questionnaire by students

Validator	Aspect	Validator value	Criteria
Small Group Students	Happiness	3.55	Effective
	Curiosity	3.60	Effective
	Activity	3.65	Effective
	Attention	3.68	Effective
	Interest	3.55	Effective
	Whole	3.60	Effective
Large Group Students	Happiness	3.49	Effective
	Curiosity	3.42	Effective
	Activity	3.70	Effective

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	Attention	3.52	Effective
	Interest	3.45	Effective
	Whole	3.51	Effective

Based on table 6, it was obtained data that the five aspects assessed were categorized as effective with an average score of 3.49 for the pleasure aspect, 3.42 for the curiosity aspect, 3.70 for the active aspect, 3.52 for the attention and 3.45 for the interest aspect. As for the overall value of the student response questionnaire to this digital teaching material, an average of 3.51 is in the range $3{,}26 < \bar{x} \leq 4{,}00$ so that it enters the effective criteria.

5. Conclusion

Based on the results of the research that has been carried out, it can be concluded that all stages of research and development have been carried out properly and resulted in a product in the form of digital teaching materials based on the Macromedia flash application in comparison material for class VII SMP which has valid criteria with a validity score of 3.70 for the material and 3 .50 for the media, practical with a practicality score of 3.60 for small groups and 3.51 for large groups, and effective with an effectiveness score of 90% for small groups and 86% for large groups.

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