DESIGNING DIGITAL TEACHING MODULE BASED ON MATHEMATICAL COMMUNICATION SKILL IN RELATION AND FUNCTION

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Abstract. This research is about designing digital module based on mathematical communication skills. This is a qualitative research with development research type. This research is done in the background of lack use of learning media and low mathematical communication skills of students in the topic of relations and functions. One solution to overcome the problems is by designing digital teaching modules through maximizing the use of media in order to improve students' mathematical communication skills in learning relations and functions. This study uses the research and development method or ADDIE (Analysis, Design, Development, implementation, Evaluation). The results of this study indicate that the digital module is very good to be used with a total expert validation of 90% which can be interpreted as highly valid, besides that the students' response to the digital module has been very good, with a total response criterion of 93.5% which can be interpreted as very good. It can be concluded that the digital module that has been created can be used in the learning process.

Keywords: Mathematical Communication, Digital Module, ADDIE.

INTRODUCTION

The development of information and communication technology today is very rapid and affects all aspects of life. Advancement in technology has encouraged humans to improve efficiency and effectiveness in each of their activities. In the world of education, media and technology have important influences too. For example, mobile phones, computers, and the internet have an influence on the learning process. At present, education in Indonesia has also been heavily influenced by globalization, technological development, information, and communication (Asrial et al, 2019; Yunos et al., 2019). Some technology has been developed in the field of mathematics so that learning mathematics becomes easier. There are many learning media that can be used, one of them is the application module and mathematics interactive learning media. With the advancement of information technology (ICT), the tools to improve student skills can increase, this has an impact on the ability of students to work together to work productively (Saadati, et al., 2014; Othman & Amiruddin, 2010; Ismail et al., 2017). Module not only contains summaries of material and training but also covers how students build knowledge about previous knowledge (Hamdunah,2016). In addition, Rosita (2016) said that modules have

a very important role in achieving the goals of education, for which modules must adjust to the characteristics of the social environment of the students.

Communication is a way to solve and clarify a problem through understanding. Sundayana, et al (2017) also said that communication is a central force for students in developing and formulating concepts. The communication process also helps build the meaning and determination of ideas and publish them (Sumarwati, Yunos & Ibrahim, 2017; Amiruddin et al., 2015). Qohar (2013: 60) says the purpose of communication is to connect mathematical ideas to express situations or problems. When students are challenged to think and give reasons on mathematic problems, and to communicate the results of their thoughts to others verbally or in writing, they learn to explain and convince. In other words, mathematical communication skills are the ability of students to express mathematical ideas with symbols, tables, diagrams or other media to solve mathematical problems (Saragih dan Yusra, 2016).Mathematical communication skills are very important for students so that in learning they can solve mathematical problems using good reasoning (Tinungki, 2015). This is in line with the statement of Janita (2016) who says that mathematical communication skills are very important, even the low student learning achievement is closely related to students' inability to communicate the material being studied, and according to Alhaddad, et al. (2015) revealed that communication skills are able to support other mathematical abilities, one of which is problem solving ability, with good communication skills, the problems will be resolved properly.

Rachmayani's study (2014:21) shows that students' communication skill is still low, so that it needs further evaluation with different methods by which we expect that students feel motivated again especially in developing mathematical ideas based on students' mathematical communication skill. Based on the result of the interview on teachers and several students in SMPN 1 Beber, it is found that students are not yet able to communicate the lesson material on relation and function well.

Based on the initial observation by giving a try-out test, it is found out that students; mathematical communication is still low. This can be seen from the test items that measure the students' mathematical communication skill, and one example of students' answers can be seen in the Figure1 below.

Function f is expressed with the form f(x) = ax + b, if f(2) = 13 and f(5) = 22, the value of a and b are ...

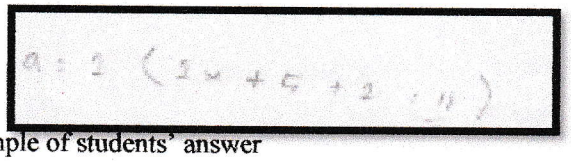

Figure 1. An example of students' answer

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In figure 1 the student's answer shows that he/she is not yet able to explain mathematical ideas of algebra form either verbally or in written because the student is actually expected to be able to solve it by substituting the value of the function to the formula. Similar mistakes are also found in some other students' answer sheet with the percentage of mistakes reaching 86.7%. Furthermore, the students are also not yet able to relate real object, pictures, and diagram to mathematical expressions, and the percentage of mistakes is 80%. The students are not yet able to express contextual problems in mathematical expression with the percentage of 70%. For this reason, it is necessary to evaluate the achievement of good learning and can provide an understanding of the material to students.

Research on modules based on mathematical communication skills has been carried out by Saifiyah (2017). The results showed that the use of teaching modules can improve students 'mathematical communication skills and can affect students' learning motivation. Nowadays modules are increasingly being developed to facilitate students in learning and absorbing material. The wide spread use of computer and internet has urged the development of software (Yalman M,2014). One of them is flipbook media which uses 3D Page flip. Modules using flipbook media are considered effective in overcoming student learning problems because flipbooks are new to students and have a variety of interesting features, making learning not boring. Multimedia flipbooks have the characteristics of hypermedia and have many interesting features than printed books (Arsyad,2011). Using flipbook media, the scores of students in the limited trials reached the highest index with 80.63 and 74.26 (Andini et al, 2018). In addition, in the study of Bakri (2016) showed that the results of the digital physics module trial used by students showed a module success of 84.45%. Previous studies have urged the writer to develop a digital learning material in mathematics using 3D Pageflip Professional for Junior High School level. The developed learning material is more interesting because it contains learning videos, interactive exercises and questions focused on mathematics communication skill.

In the research the researcher therefore uses the PageFlip Professional 3D application which in its implementation will be collaborated with various kinds of files such as learning videos or flash. With the purpose of producing textbooks that are more interesting and fun for students with the concept of developing mathematical communication skill students are expected to be able to develop mathematical ideas that are useful for their skill and self confidence. The formulation of the problems are: 1) What are the results of the e-module design in Relations and Functions assisted by Professional PageFlip 3D software 2) How is the use of the digital materials in teaching relations and function 3) How would students respond after using digital teaching materials in relations and functions.

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METHOD

The method used in this study was the ADDIE (*Analysis, Design, Development, implementation, Evaluation*) with a modification that it proceeds only to implementation step. By conducting research and development methods, we can provide good design and produce an efficient learning module. The research subjects in the implementation of digital module were class VIII D Beber 1 Junior High School, which consisted of 40 students, while the subject of the initial trial was students of class VIII C of Beber 1 Junior High School consisting of 40 people.

This research was conducted to find out who then compiled a module design that corresponds to the ADDIE research stage. Tegeh (2013) suggests research and development is an effort to develop a product that is used to overcome classroom learning. Purbasari (2013) states that the ADDIE research model is able to maximize the role of valid learning media. According to Aldoobie (2015) ADDIE design has systematic research and development stages, namely:

(1) Analyze. This stage is done to obtain an overview of students' need and math curriculum in junior high school level. The activities done in this stage are among others: interview with students to get information about problems in learning math, interview with teachers to get information about problems in creating text book and the possibility of using digital learning material in the school, give try-out questions, and analyze math curriculum in junior high school.

(2) Design. Based on the results of the analysis, the next stage is the design stage or product design stage which includes: Making media design (media concept), preparing teaching material formats, choosing a presentation approach that is a scientific approach based on the 2013 curriculum, and making a blue print.

(3) Development. At this stage the design that was created at the previous stage is realized into a product that is ready to be used. Activities carried out at the development stage include: product creation and expert validation

(4) Implementation. The implementation stage is the stage of trying the digital teaching materials directly to students. Before learning, students work on pre-test questions and form study groups. After learning is done, students fill out a questionnaire and work on the post test questions.

(5) Evaluation. The evaluation stage is carried out to ensure that the product being developed is appropriate, or it still needs revision. Activities at the evaluation stage

include: product revision by the validator, implementation reflection, and revision of digital teaching materials based on the results of implementation reflection. The concern at this stage is the validator's suggestion, students 'obstacles in learning relations and functions using the developed digital teaching materials, teachers' obstacles in using digital teaching materials, student responses and learning outcomes on the topic discussed.

Data collection techniques used include tests of mathematical communication skills, interviews with teachers and students, validation sheets of learning modules to determine the level of validity of the module, student response questionnaires to find out how students respond to modules that have been made.

RESULT AND DISCUSSION

The result of this media development is in the form of a digital teaching module based on mathematical communication skill using the Professional PageFlip 3D application by loading lesson material on relations and functions into the application. The module can be used anywhere, but because it contains flash, the finished images and videos can only be seen on a Windows-based PC. The following is the result of module analysis based on the ADDIE design.

Analysis Phase

At the analysis stage, the data obtained from the questionnaire and tests were analyzed to find out the ability of students in understanding the lesson material. From the results obtained it can be concluded that the students still have difficulties understanding the lesson material of relations and functions. Many factors cause this to happen including the material presented by the teacher is confusing, the teacher's teaching method is monotonous so students feel bored, and the last is no media used in learning so that the material taught does not create a spirit of learning for students. In addition students want a new thing that can help them learn mathematics easier, especially in the topic of relations and functions.

Also when the researcher conducted an initial test of student knowledge, the results obtained showed that some students did not understand the material of relations and functions, which can be seen from the test results which are fairly low.

Design Phase

The initial stage of designing a digital module starts from creating a framework using Microsoft Word applications. In this stage the preparation of the framework is very important because it includes the design of the module layout, placement of materials, placement of image

layouts, as well as the placement of motivational words for students. After this stage is completed the module framework is converted into a PDF format. Next, we create questions that are arranged systematically using the Adobe Flash CS 6 application. Then we add complementary accessories for the module, including making an initial video for learning using the Camtasia and Wondershare Filmora application. Next we make reinforcement images using CorelDraw and Photoshop applications. The final stage is the core process of making digital teaching modules, namely inserting and designing, using the PageFlip Professional 3D application. At this stage all the things that we have prepared for the digital module will be processed, starting from the initial stage of entering the module framework in the form of a PDF file, selecting the module background layout up to the module theme. Then we enter the discussion questions in the form of SWF format, videos, and images by connecting the problem files with the 3D PageFlip application. The digital teaching module framework at the design stage can be seen in Figure 2.

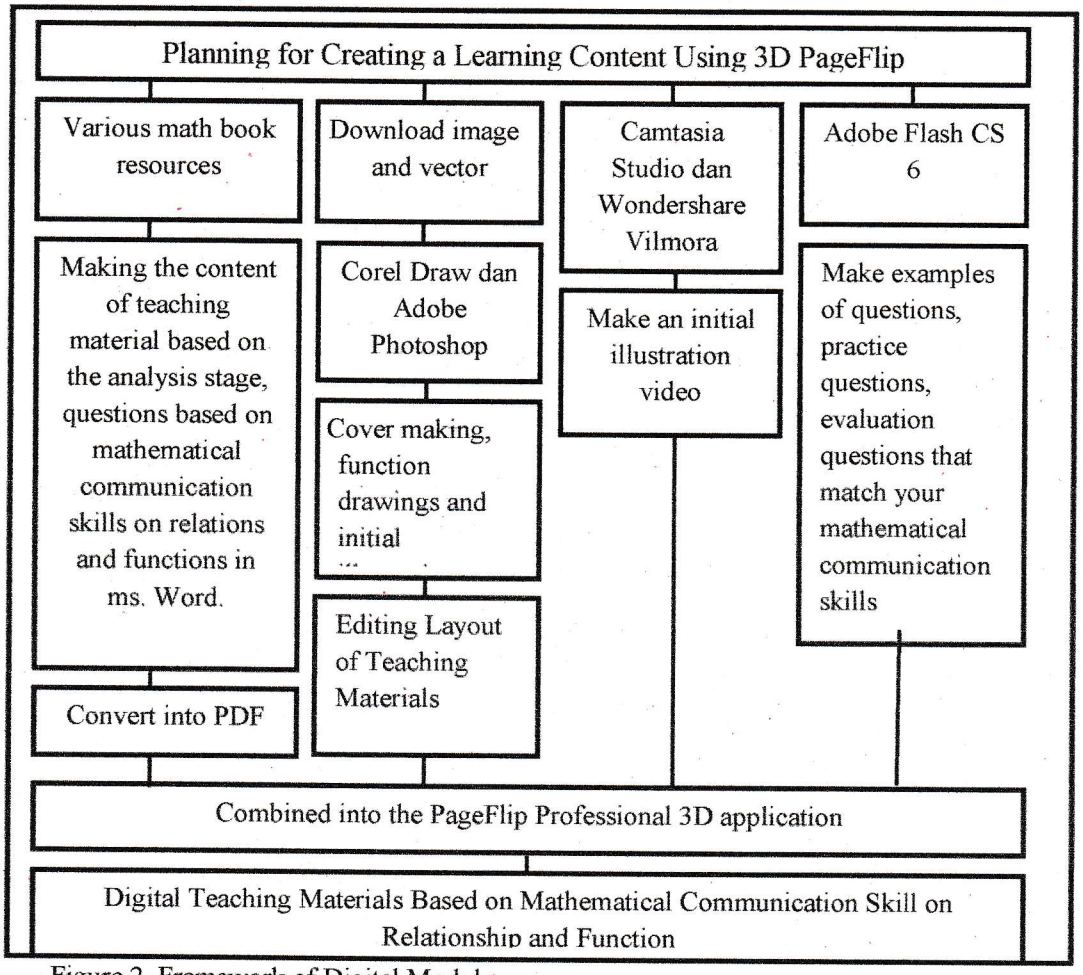

Figure 2. Framework of Digital Module

Development phase

After the digital module has been completed, the final step is to change the format of the module which could only be opened when there is a 3D PageFlip application to the EXE format (application), meaning that the module can be opened on a PC. After the module can run properly then validation will be carried out by experts. Students' responses as media users are also collected. Operate the digital teaching module by clicking the right or left arrow if you want to change the page as shown in Figure 3, and click the icon if you want to see videos, pictures and reinforcement questions.

Figure 3. Left and Right Arrow for turning page

The main page display of the digital teaching module is shown in Figure 4. After the main page you can go to the preface and table of content page. On this menu list the page link is already listed. This is to facilitate the user in the operation, if you want to go to a specific page directly click on the desired content menu.

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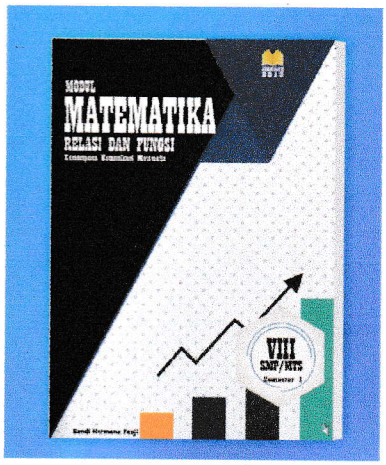
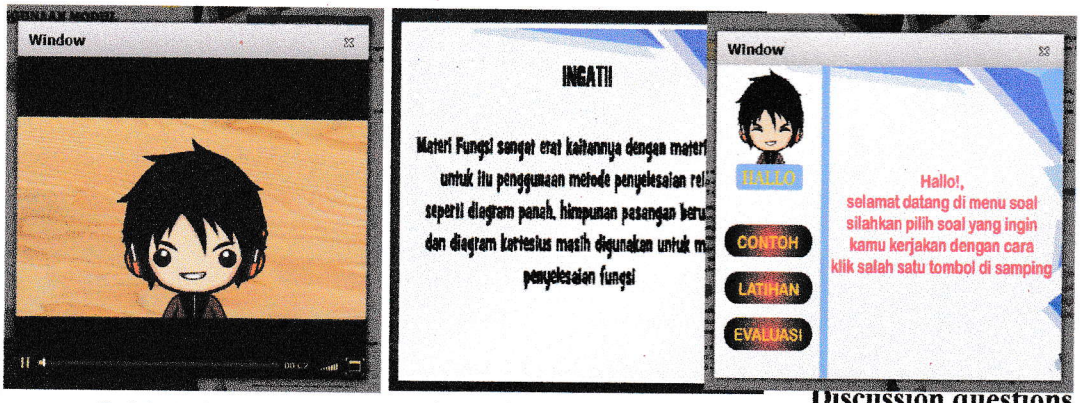


Figure 4. Initial display of the Teaching module

Also included in the digital module are some interesting features so that students are more motivated in learning including the introductory video of the teaching module, reinforcement material, and discussion questions. The feature is seen in Figure 5 below.



Initial video **Reinforcement** **Discussion questions on relation and**

Gambar 5. Some Features in the Digital Module

At this stage the module is tested by asking for validation from a number of good validators from the field, after conducting the validation stage the module is tested on several students who represent each desired aspect. Media validation was carried out by four validators. Three validators are from Swadaya Gunung Jati University lecturers and one validator is from the mathematics teacher. The following are the results of media validation from each aspect of the indicators of each expert as referred to in table 1

Table 1. Results of Validation for Each Aspect of Indicators

Validator	Scores Achieved at Each Aspect				Validation Criteria for Each Aspect			
	1	2	3	4	1	2	3	4
Validator 1	37	22	31	12	92.5%	92%	86.1%	100%
Validator 2	39	24	33	12	97.5%	100%	91.7%	100%
Validator 3	37	20	31	12	92.3%	83%	86.1%	100%
Validator 4	40	24	36	12	100%	100%	100%	100%
Average for each aspect					95.6	93.4	91	100

Information :

Aspect 1: Content Feasibility

Aspect 2: Feasibility of Presentation

Aspect 3: Language Feasibility

Aspect 4: Mathematical Communication Skill

In the aspect of content feasibility the average score is 95.6% with very valid criteria, in terms of content feasibility assessed how the suitability of the material to KI and KD, measuring the accuracy of the material, looking at material updates to measure whether the modules that have been made can stimulate students' curiosity. This is in line with BSNP (2014) which states that a good module must correspond to basic competencies, accurate and up-to-date. The curriculum contained in the module corresponds to the current curriculum, namely the 2013 curriculum with syllabus states the meaning of relationship, states the meaning of relations, determines the function notation, determines the number of functions and understands the form of one-on-one correspondence functions.

In the aspect of feasibility, the presentation obtained an average of 93.4% with very valid criteria, in the aspect of feasibility the presentation must meet the assessment criteria for inclusion of presentation including how the concept presents the digital teaching module, additional presentation and how the thinking flow coherence in the teaching module. This corresponds to the opinion of Islamiyah (2015) which states that a good module must have a systematic, consistent, coherent and complete presentation. The illustrations of the feasibility of presenting in modules, including modules, must have a bibliography, introduction, and glossary. In addition, the way the module is presented must also be arranged so that students will more easily understand the textbooks we have made.

In the aspect of language feasibility, it obtains an average of 91% with very valid criteria.

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In the language feasibility aspect we are required to obey the applicable language rules, the criteria that must be met are: the grammar must be straightforward, communicative, dialogical and interactive besides the content in the module must be adapted to the development of the students. In line with the statement by Islamiyah (2015) which states that a good module must adjust to the level of student development, readability, and motivational ability, it aims to make the digital module that we make useful for students and can motivate students to learn mathematics, especially in the topic of relations and function.

In making the questions in the module, it must be in accordance with the mathematical abilities planned. On the aspect of mathematical communication ability, the average validity is 100% with very valid criteria. In this case, the questions contained in the module have referred to three indicators of mathematical communication skills that are expected so that students can improve their ability to communicate in learning.

Overall, the average validation results were 95.1% of the total validators with very valid interpretation. This refers to Akbar's (2013) validity criteria saying that 85.01-100% has a very validity level and the module can be used without revision.

Implementation Phase

The implementation of teaching modules that have been made is done in class VIII D of State Junior High School 1 Beber. At the stage of preparing teaching, the researcher prepares everything needed in learning including preparing the digital module, lesson plan, and media such as laptops and projectors in addition to preparing the tools and equipment needed by researchers also ensuring that students are ready to carry out the learning process including students already know the information material that must be learned, what devices should be used and so on. It is intended that when the learning process takes place, students are ready to enjoy the process.

The stage of regulating the learning environment is the final process in the implementation phase. At this stage, the researcher prepares the class used for research; in this case, the arrangement of the classroom atmosphere determines the success of a study. After everything was done as planned, the researchers then carried out teaching using digital modules and laptops as learning media as seen in figure 6. After the teaching is done, the researcher prepares a response questionnaire to find out the students' responses to the teaching modules they have used.

Figure 6. The Implementation of Digital Module

The implementation starts from the introduction which explains the core competencies, basic competencies and learning objectives. As for the core part of learning the researcher explains the material available in the learning media which is "Relation and Function" and provides examples of questions with the discussion contained in the learning media either in the form of picture slides or videos to be observed by students. In this process it appears that students pay attention to and enjoy observing the material provided by the author. The media used arouse curiosity of students by observing the examples of questions given.

Based on the results of overall data analysis mathematical representation abilities with learning media using 3D PageFlip Professional in learning activities in the classroom experienced a significant increase with an average N-Gain results of 0.41 and included in the medium criteria. Obtained average results of Gain test analysis with moderate criteria can be interpreted that an increase in students' mathematical communication skills occurs as a whole. So the learning media helps teachers to be able to improve the learning process. This is in line with research conducted by (Febrianti, et al: 2017) with the results obtained in these studies it can be concluded that the digital physics module based on discovery learning on the subject of straight motion kinematics has met the criteria very well and is worthy of being used as an independent teaching material for students and introduced to students or implemented in learning to run effectively with the learning media in the form of digital modules and can improve students' cognitive abilities.

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After the teaching module is tested for validation by the validator and produces a digital teaching module in the form of an exe application that can be opened anywhere, then it is tested to find out the user's response. The following are the results of the media response from each aspect of the indicators of each expert as referred to in Table 2.

Table 2. Responses of students from each class

Ability Classification	Total response score	Percentage	Criteria
High	520	90,3%	Very good
Medium	509	88,4%	Very good
Low	522	90,7%	Very good

Based on the results of research conducted on 18 users with high, medium, and low levels of ability, 18 students responded with very good criteria. According to Riduwan (2013), the criteria for interpreting responses of 81% - 100% are included as very good category. With the overall data obtained from 18 users at 93.5%, it can be concluded that students' responses to digital teaching materials are very good. The results of the response test for digital textbooks for each aspect can be seen with the following assessment:

In the aspects of the learning process, the average percentage is 92.6% with very good criteria. The aspects of the learning process include the ease of modules in the teaching and learning process, can provide motivation during learning and support the appropriate learning steps. In the explanation of aspects of the learning process, it refers to the use of modules with the teaching and learning process. Module as teaching material must be said to be able to explain learning material well and easily understood by students (Prastowo, 2015). The use of technology in making teaching modules is an innovation in teaching and learning which can help students understand the lesson material so that it will improve their learning achievement (Mendoza J dan Mendoza I, 2018).

The aspects of the module content obtained an average percentage of 96.3% with very good criteria. The aspects of the module content include how students are interested in the contents of the modules that have been made, including an understanding of the module, clarity of language and terms, practicality of modules, questions contained in the module and supporting information for the module. This is consistent with the statement of Daryanto (2013) which states that the use of language that is easy to understand and characteristics of a good module can improve students' ability to digest the material, so students can understand the meaning of the content in the module.

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Research on digital teaching modules has also been conducted by Andini, et al (2018). In Andini's research et al, it only focused on elementary school teaching, so I wanted to try making a digital module design specifically for junior high school children because in reality junior high school students tend to demand interesting and different learning experience from what they had before. This is to increase students' creativity, they can also increase their knowledge in information technology. The study of the SMP-based module was also conducted by Johar, et al (2018), the weakness of the research is that the modules used are still monotonous and students in some schools still complain that the module which is a text-book is less helpful in creative thinking, and some mathematical problems are still difficult to solve.

In this study the researchers tried to answer the problems that are mentioned by students regarding the obstacles in finding textbooks. In this study the researchers made a module that is digital, meaning that the module can be seen anywhere and arranged in such a way so that it is easily understood by students, besides that with digital-based modules, students will be interested in knowing the contents of the lesson being discussed, besides with adding questions with the help of the Adobe Flash application, students are more interested in learning the material.

EVALUATION STAGE

This evaluation phase can occur at any of the four stages above and is in accordance with the revision needs. At the development stage, product evaluation is carried out based on the suggestions from several validators for improvement, which are listed in the table below:

Validators' Suggestion

Validator	Suggestion	After revision
Validator 1	A glossary should be made	There is a glossary in the revised module
	Improve writing	The writing is in accordance with the grammar
Validator 2	Improve writing and punctuation	The writing has been improved and in accordance with the grammar rules
	Questions of discussion and	Questions of discussion and evaluation

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	evaluation should be added with story problems	include story problems related to daily life
	It is better to include the benefits and origin of the relation function	There is the biography and benefits or learning lesson material on relations and functions both in the classroom and in everyday life's context
Validator 3&4	No suggestion	-

Furthermore, the evaluation phase is also carried out during the reflection on the implementation of learning using a digital module and revision of the digital module based on the results of reflection on the implementation. Obstacles that occur during the learning process are because this learning media is new to students, some students focus on experimenting with digital modules so that they do not pay attention to teacher's instructions. The application of technology is an important factor for improving student learning outcomes, but the main factor is still the learning and teaching process (Nadiyah and Faaizah, 2015). For further development the digital module will be designed to support on mobile phones. This is done so that students are free to learn wherever and whenever they want. When in classroom students are more focused on learning. Besides that, the number of laptops provided is still limited, so there are some students who passively pay attention to the lesson. Barriers to the learning process not only come from students, but also teachers. In the implementation process the class teacher acts as an observer, but has not been able to develop the digital module further. Therefore, further training is needed so that teachers can make their own module according to students' needs and material. This digital module cannot be a single evaluation instrument, so if you want to evaluate students' achievement there must be a companion instrument.

CONCLUSION

The learning media or the digital module that has been developed is in accordance with the students' needs. The digital module becomes an alternative source of learning which is interesting, not monotonous and new. The digital module that has been developed is very valid based on the evaluation of four validators. After implementing learning using a digital module,

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students respond positively, and it can provide encouragement to the students to develop their mathematical knowledge. Some obstacles experienced by students in using digital module include the lack of focus on what is explained by the teacher. Therefore, for further development there needs to be innovations such as making the digital module support on mobile phones. This is done so students can learn the material first at home and try all the features contained in the digital module. When they come to class, they have more discussion with the teacher. As for teachers, the development of the digital module provides stimulus to develop on other topics. The results of this study provide recommendations that there is a need for quantitative research to test the effectiveness of the use of digital modules in the classroom.

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Head of Academic Affairs

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Abstract

This research is about designing digital module based on mathematical communication skills. This is a qualitative research with development research type. This research is done in the background of lack use of learning media and low mathematical communication skills of students in the topic of relations and functions. One solution to overcome the problems is by designing digital teaching modules through maximizing the use of media in order to improve students' mathematical communication skills in learning relations and functions. This study uses the research and development method or ADDIE (Analysis, Design, Development, implementation, Evaluation). The results of this study indicate that the digital module is very good to be used with a total expert validation of 90% which can be interpreted as highly valid, besides that the students' response to the digital module has been very good, with a total response criterion of 93.5% which can be interpreted as very good. It can be concluded that the digital module that has been created can be used in the learning process.

Keywords: Mathematical Communication, Digital Module, ADDIE.

Abstrak

Penelitian ini mengenai desain modul digital berbasis kemampuan komunikasi matematis. Jenis penelitian yang digunakan yaitu kualitatif berupa penelitian pengembangan. Penelitian ini didasarkan dengan lemahnya penggunaan media dalam pembelajaran dan rendahnya kemampuan komunikasi matematis siswa pada materi relasi dan fungsi. salah satu solusi untuk mengatasi permasalahan yang dialami, yaitu dengan mendesain modul ajar digital dengan memaksimalkan penggunaan media dalam pembelajaran agar mampu mendorong kemampuan komunikasi matematis siswa dalam mempelajari materi relasi dan fungsi. Penelitian ini menggunakan metode penelitian dan pengembangan ADDIE (Analisis, Design, Development, implementation, Evaluation). Hasil dari penelitian ini menunjukan bahwa modul digital sangat baik digunakan dengan validasi ahli total sebesar 90% dengan interpretasi media sangat valid, selain itu respons siswa terhadap modul digital yang telah dibuat sangat baik, dengan kriteria respons total sebesar 93,5% dengan interpretasi respons sangat baik. Dapat disimpulkan bahwa modul digital yang telah dibuat dapat digunakan dalam proses pembelajaranAbstrak dibuat dalam 2 bahasa, yaitu bahasa Indonesia dan bahasa inggris. Edisi bahasa Indonesia merupakan terjemahan dari abstrak dalam bahasa inggris dengan format sama seperti abstrak dalam bahasa inggris.

Kata kunci: Komunikasi Matematis, Modul Digital, ADDIE.

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The development of information and communication technology today is very rapid and affects all aspects of life. Advancement in technology has encouraged humans to improve efficiency and effectiveness in each of their activities. In the world of education, media and technology have important influences too. For example, mobile phones, computers, and the internet have an influence on the learning process. At present, education in Indonesia has also been heavily influenced by globalization, technological development, information, and communication (Asrial et al, 2019; Yunos et al., 2019).

Some technology has been developed in the field of mathematics so that learning mathematics becomes easier. There are many learning media that can be used, one of them is the application module and mathematics interactive learning media. With the advancement of information technology (ICT), the tools to improve student skills can increase, this has an impact on the ability of students to work together to work productively (Saadati, et al., 2014; Othman & Amiruddin, 2010; Ismail et al., 2017). Module not only contains summaries of material and training but also covers how students build knowledge about previous knowledge (Hamdunah,2016). In addition, Rosita (2016) said that modules have a very important role in achieving the goals of education, for which modules must adjust to the characteristics of the social environment of the students.

Communication is a way to solve and clarify a problem through understanding. Sundayana, et al (2017) also said that communication is a central force for students in developing and formulating concepts. The communication process also helps build the meaning and determination of ideas and publish them (Sumarwati, Yunos & Ibrahim, 2017; Amiruddin et al., 2015). The purpose of communication is to connect mathematical ideas to express situations or problems (Qohar, 2013). When students are challenged to think and give reasons on mathematic problems, and to communicate the results of their thoughts to others verbally or in writing, they learn to explain and convince. In other words, mathematical communication skills are the ability of students to express mathematical ideas with symbols, tables, diagrams or other media to solve mathematical problems (Saragih dan Yusra, 2016).Mathematical communication skills are very important for students so that in learning they can solve mathematical problems using good reasoning (Tinungki, 2015). This is in line with the statement of Janita (2016) who says that mathematical communication skills are very important, even the low student learning achievement is closely related to students' inability to communicate the material being studied, and according to Alhaddad, et al. (2015) revealed that communication skills are able to support other mathematical abilities, one of which is problem solving ability, with good communication skills, the problems will be resolved properly.

Rachmayani's study (2014) shows that students' communication skill is still low, so that it needs further evaluation with different methods by which we expect that students feel motivated again especially in developing mathematical ideas based on students' mathematical communication skill. Based on the result of the interview on teachers and several students in State Junior High School 1 Beber, it is found that students are not yet able to communicate the lesson material on relation and function well. Based on the initial observation by giving a try-out test, it is found out that students; mathematical communication is still low. This can be seen from the test items that measure the students' mathematical communication skill, and one example of students' answers can be seen in the Figure 1 below.

Function f is expressed with the form f(x) = ax + b, if f(2) = 13 and f(5) = 22, the value of a and b are .....

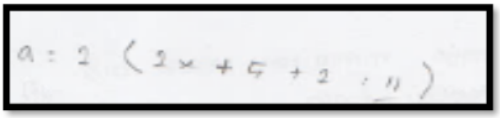


Figure 1. An example of students' answer

In Figure 1 the student's answer shows that he/she is not yet able to explain mathematical ideas of algebra form either verbally or in written because the student is actually expected to be able to solve it by substituting the value of the function to the formula. Similar mistakes are also found in some other students' answer sheet with the percentage of mistakes reaching 86.7%. Furthermore, the students are also not yet able to relate real object, pictures, and diagram to mathematical expressions, and the percentage of mistakes is 80%. The students are not yet able to express contextual problems in mathematical expression with the percentage of 70%. For this reason, it is necessary to evaluate the achievement of good learning and can provide an understanding of the material to students.

Research on modules based on mathematical communication skills has been carried out by Saifiyah (2017). The results showed that the use of teaching modules can improve students 'mathematical communication skills and can affect students' learning motivation. Nowadays modules are increasingly being developed to facilitate students in learning and absorbing material. The wide spread use of computer and internet has urged the development of software (Yalman M, 2014). One of them is flipbook media which uses 3D Page flip. Modules using flipbook media are considered effective in overcoming student learning problems because flipbooks are new to students and have a variety of interesting features, making learning not boring. Multimedia flipbooks have the characteristics of hypermedia and have many interesting features than printed books (Arsyad, 2011). Using flipbook media, the scores of students in the limited trials reached the highest index with 80.63 and 74.26 (Andini et al, 2018). In addition, in the study of Bakri (2016) showed that the results of the digital physics module trial used by students showed a module success of 84.45%. Previous studies have urged the writer to develop a digital learning material in mathematics using 3D Pageflip Professional for Junior High School level. The developed learning material is more interesting because it contains learning videos, interactive exercises and questions focused on mathematics communication skill.

In the research the researcher therefore uses the PageFlip Professional 3D application which in its implementation will be collaborated with various kinds of files such as learning videos or flash. With the purpose of producing textbooks that are more interesting and fun for students with the concept of developing mathematical communication skill students are expected to be able to develop mathematical ideas that are useful for their skill and self confidence. The formulation of the problems are: 1) What are the results of the e-module design in Relations and Functions assisted by Professional PageFlip 3D software 2) How is the use of the digital materials in teaching relations and function 3) How would students respond after using digital teaching materials in relations and functions.

METHOD

The method used in this study was the ADDIE (Analysis, Design, Development, implementation,

Evaluation) with a modification that it proceeds only to implementation step. By conducting research and development methods, we can provide good design and produce an efficient learning module. The research subjects in the implementation of digital module were class VIII D in State Junior High School 1 Beber, which consisted of 40 students.

This research was conducted to find out who then compiled a module design that corresponds to the ADDIE research stage. Tegeh (2013) suggests research and development is an effort to develop a product that is used to overcome classroom learning. Purbasari (2013) states that the ADDIE research model is able to maximize the role of valid learning media. According to Aldoobie (2015) ADDIE design has systematic research and development stages, namely:

Analyze

This stage is done to obtain an overview of students' need and math curriculum in junior high school level. The activities done in this stage are among others: interview with students to get information about problems in learning math, interview with teachers to get information about problems in creating text book and the possibility of using digital learning material in the school, give try-out questions, and analyze math curriculum in junior high school.

Design

Based on the results of the analysis, the next stage is the design stage or product design stage which includes: Making media design (media concept), preparing teaching material formats, choosing a presentation approach that is a scientific approach based on the 2013 curriculum, and making a blue print.

Development

At this stage the design that was created at the previous stage is realized into a product that is ready to be used. Activities carried out at the development stage include: product creation and expert validation.

Implementation

The implementation stage is the stage of trying the digital teaching materials directly to students. Before learning, students work on pre-test questions and form study groups. After learning is done, students fill out a questionnaire and work on the post test questions.

Evaluation

The evaluation stage is carried out to ensure that the product being developed is appropriate, or it still needs revision. Activities at the evaluation stage include: product revision by the validator, implementation reflection, and revision of digital teaching materials based on the results of implementation reflection. The concern at this stage is the validator's suggestion, students 'obstacles in learning relations and functions using the developed digital teaching materials, teachers' obstacles in using digital teaching materials, student responses and learning outcomes on the topic discussed.

Data collection techniques used include tests of mathematical communication skills, interviews with teachers and students, validation sheets to determine the level of validity of the module, student response

questionnaires to find out how students respond to modules that have been made.

RESULTS AND DISCUSSION

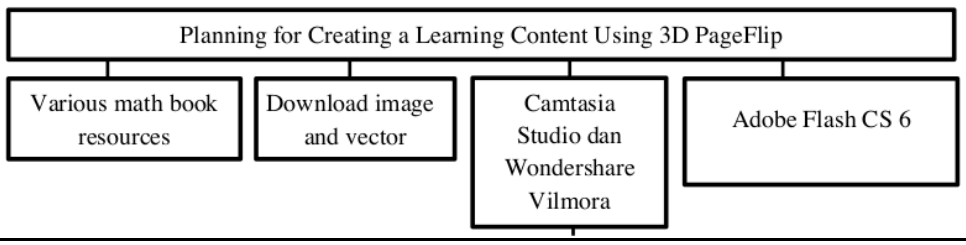
The result of this media development is in the form of a digital teaching module based on mathematical communication skill using the Professional PageFlip 3D application by loading lesson material on relations and functions into the application. The module can be used anywhere, but because it contains flash, the finished images and videos can only be seen on a Windows-based PC. The following is the result of module analysis based on the ADDIE design.

Analyze Phase

At the analysis stage, the data obtained from the questionnaire and tests were analyzed to find out the ability of students in understanding the lesson material. From the results obtained it can be concluded that the students still have difficulties understanding the lesson material of relations and functions. Many factors cause this to happen including the material presented by the teacher is confusing, the teacher's teaching method is monotonous so students feel bored, and the last is no media used in learning so that the material taught does not create a spirit of learning for students. In addition students want a new thing that can help them learn mathematics easier, especially in the topic of relations and functions. Also when the researcher conducted an initial test of student knowledge, the results showed that some students did not understand the material of relations and functions, which can be seen from the test results which are fairly low.

Design Phase

The initial stage of designing a digital module starts from creating a framework using Microsoft Word applications. In this stage the preparation of the framework is very important because it includes the design of the module layout, placement of materials, placement of image layouts, as well as the placement of motivational words for students. After this stage is completed the module framework is converted into a PDF format. Next, we create questions that are arranged systematically using the Adobe Flash CS 6 application. Then we add complementary accessories for the module, including making an initial video for learning using the Camtasia and Wondershare Filmora application. Next we make reinforcement images using CorelDraw and Photoshop applications. The final stage is the core process of making digital teaching modules, namely inserting and designing, using the PageFlip Professional 3D application. At this stage all the things that we have prepared for the digital module will be processed, starting from the initial stage of entering the module framework in the form of a PDF file, selecting the module background layout up to the module theme. Then we enter the discussion questions in the form of SWF format, videos, and images by connecting the problem files with the 3D PageFlip application. The digital teaching module framework at the design stage can be seen in Figure 2.



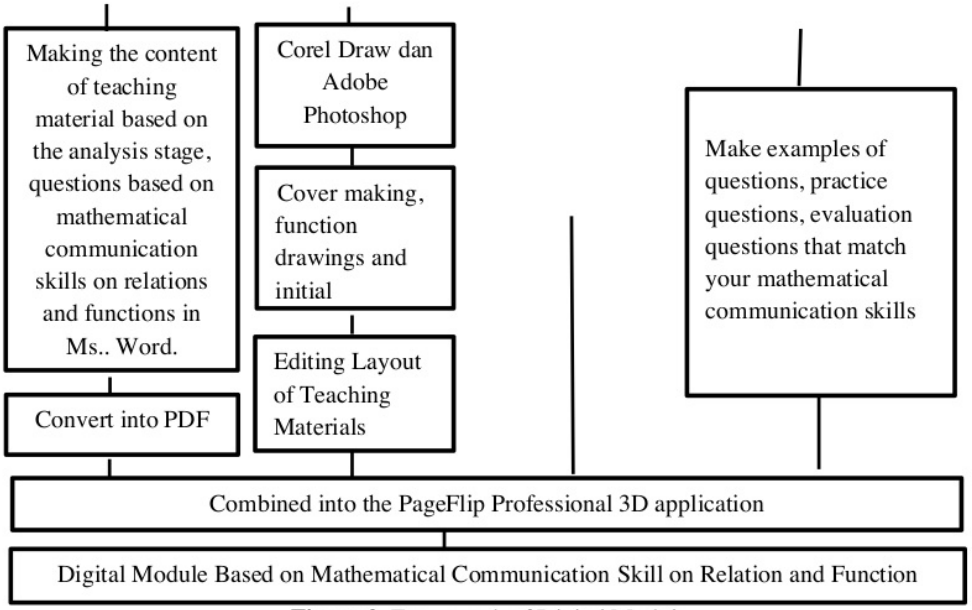


Figure 2. Framework of Digital Module

Development Phase

After the digital module has been completed, the final step is to change the format of the module which could only be opened when there is a 3D PageFlip application to the EXE format (application), meaning that the module can be opened on a PC. After the module can run properly then validation will be carried out by experts. Students' responses as media users are also collected. Operate the digital teaching module by clicking the right or left arrow if you want to change the page as shown in Figure 3, and click the icon if you want to see videos, pictures and reinforcement questions.

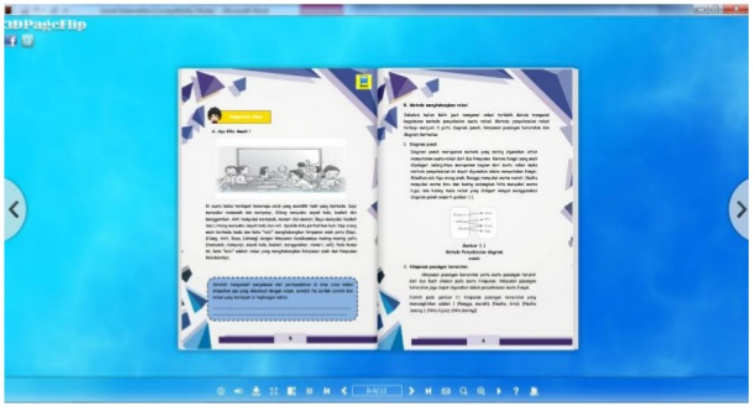


Figure 3. Left and Right Arrow for Turning Page

The main page display of the digital teaching module is shown in Figure 4. After the main page you

can go to the preface and table of content page. On this menu list the page link is already listed. This is to facilitate the user in the operation, if you want to go to a specific page directly click on the desired content menu.

Figure 4. Initial Display of the Digital Module

Also included in the digital module are some interesting features so that students are more motivated in learning including the introductory video of the teaching module, reinforcement material, and discussion questions. The feature is seen in Figure 5 below.

Figure 5. Some Features in the Digital Module

At this stage the module is tested by asking for validation from a number of good validators from the field, after conducting the validation stage the module is tested on several students who represent each desired aspect. Media validation was carried out by four validators. Three validators are from Swadaya Gunung Jati University lecturers and one validator is from the mathematics teacher. The following are the results of media validation from each aspect of the indicators of each expert as referred to in Table 1.

Table 1. Results of Validation for Each Aspect of Indicators

Validator	Scores Achieved at Each Aspect				Validation Criteria for Each Aspect			
	1	**2**	**3**	**4**	**1**	**2**	**3**	**4**
Validator 1	37	22	31	12	92.5%	92%	86.1%	100%
Validator 2	39	24	33	12	97.5%	100%	91.7%	100%
Validator 3	37	20	31	12	92.3%	83%	86.1%	100%
Validator 4	40	24	36	12	100%	100%	100%	100%
Average for each aspect					95.6	93.4	91	100

Information :

Aspect 1: Content Feasibility

Aspect 2: Feasibility of Presentation

Aspect 3: Language Feasibility

Aspect 4: Mathematical Communication Skill

In the aspect of content feasibility the average score is 95.6% with very valid criteria, in terms of content feasibility assessed how the suitability of the material to KI and KD, measuring the accuracy of the material, looking at material updates to measure whether the modules that have been made can stimulate students' curiosity. This is in line with BSNP (2014) which states that a good module must correspond to basic competencies, accurate and up-to-date. The curriculum contained in the module corresponds to the current curriculum, namely the 2013 curriculum with syllabus states the meaning of relationship, states the meaning of relations, determines the function notation, determines the number of functions and understands the form of one-on-one correspondence functions.

In the aspect of feasibility, the presentation obtained an average of 93.4% with very valid criteria, in the aspect of feasibility the presentation must meet the assessment criteria for inclusion of presentation including how the concept presents the digital teaching module, additional presentation and how the thinking flow coherence in the teaching module. This corresponds to the opinion of Islamiyah (2015) which states that a good module must have a systematic, consistent, coherent and complete presentation. The illustrations of the feasibility of presenting in modules, including modules, must have a bibliography, introduction, and glossary. In addition, the way the module is presented must also be arranged so that students will more easily understand the textbooks we have made.

In the aspect of language feasibility, it obtains an average of 91% with very valid criteria. In the language feasibility aspect we are required to obey the applicable language rules, the criteria that must be met are: the grammar must be straightforward, communicative, dialogical and interactive besides the content in the module must be adapted to the development of the students. In line with the statement by Islamiyah (2015) which states that a good module must adjust to the level of student development, readability, and motivational ability, it aims to make the digital module that we make useful for students

and can motivate students to learn mathematics, especially in the topic of relations and function.

In making the questions in the module, it must be in accordance with the mathematical abilities planned. On the aspect of mathematical communication ability, the average validity is 100% with very valid criteria. In this case, the questions contained in the module have referred to three indicators of mathematical communication skills that are expected so that students can improve their ability to communicate in learning.

Overall, the average validation results were 95.1% of the total validators with very valid interpretation. This refers to Akbar's (2013) validity criteria saying that 85.01-100% has a very validity level and the module can be used without revision.

Implementation Phase

The implementation of teaching modules that have been made is done in class VIII D of State Junior High School 1 Beber. At the stage of preparing teaching, the researcher prepares everything needed in learning including preparing the digital module, lesson plan, and media such as laptops and projectors in addition to preparing the tools and equipment needed by researchers also ensuring that students are ready to carry out the learning process including students already know the information material that must be learned, what devices should be used and so on. It is intended that when the learning process takes place, students are ready to enjoy the process.

The stage of regulating the learning environment is the final process in the implementation phase. At this stage, the researcher prepares the class used for research; in this case, the arrangement of the classroom atmosphere determines the success of a study. After everything was done as planned, the researchers then carried out teaching using digital modules and laptops as learning media as seen in figure 6. After the teaching is done, the researcher prepares a response questionnaire to find out the students' responses to the teaching modules they have used.

Figure 6. The Implementation of Digital Module

The implementation starts from the introduction which explains the core competencies, basic competencies and learning objectives. As for the core part of learning the researcher explains the material available in the learning media which is "Relation and Function" and provides examples of questions with the discussion contained in the learning media either in the form of picture slides or videos to be observed by students. In this process it appears that students pay attention to and enjoy

observing the material provided by the author. The media used arouse curiosity of students by observing the examples of questions given.

Based on the results of overall data analysis mathematical representation abilities with learning media using 3D PageFlip Professional in learning activities in the classroom experienced a significant increase with an average N-Gain results of 0.41 and included in the medium criteria. Obtained average results of Gain test analysis with moderate criteria can be interpreted that an increase in students' mathematical communication skills occurs as a whole. So the learning media helps teachers to be able to improve the learning process. This is in line with research conducted by (Febrianti, et al: 2017) with the results obtained in these studies it can be concluded that the digital physics module based on discovery learning on the subject of straight motion kinematics has met the criteria very well and is worthy of being used as an independent teaching material for students and introduced to students or implemented in learning to run effectively with the learning media in the form of digital modules and can improve students' cognitive abilities.

After the teaching module is tested for validation by the validator and produces a digital teaching module in the form of an exe application that can be opened anywhere, then it is tested to find out the user's response. The following are the results of the media response from each aspect of the indicators of each expert as referred to in Table 2.

Table 2. Responses of students from each class

Ability Classification	Total response score	Percentage	Criteria
High	520	90,3%	Very good
Medium	509	88,4%	Very good
Low	522	90,7%	Very good

Based on the results of research conducted on 18 users with high, medium, and low levels of ability, 18 students responded with very good criteria. According to Riduwan (2013), the criteria for interpreting responses of 81% - 100% are included as very good category. With the overall data obtained from 18 users at 93.5%, it can be concluded that students' responses to digital teaching materials are very good. The results of the response test for digital textbooks for each aspect can be seen with the following assessment.

The aspects of the module content obtained an average percentage of 96.3% with very good criteria. The aspects of the module content include how students are interested in the contents of the modules that have been made, including an understanding of the module, clarity of language and terms, practicality of modules, questions contained in the module and supporting information for the module. This is consistent with the statement of Daryanto (2013) which states that the use of language that is easy to understand and characteristics of a good module can improve students' ability to digest the material, so students can understand the meaning of the content in the module.

Research on digital teaching modules has also been conducted by Andini, et al (2018). In Andini's research et al, it only focused on elementary school teaching, so I wanted to try making a digital module design specifically for junior high school children because in reality junior high school students tend to

demand interesting and different learning experience from what they had before. This is to increase students' creativity, they can also increase their knowledge in information technology. The study of the SMP-based module was also conducted by Johar, et al (2018), the weakness of the research is that the modules used are still monotonous and students in some schools still complain that the module which is a text-book is less helpful in creative thinking, and some mathematical problems are still difficult to solve.

In this study the researchers tried to answer the problems that are mentioned by students regarding the obstacles in finding textbooks. In this study the researchers made a module that is digital, meaning that the module can be seen anywhere and arranged in such a way so that it is easily understood by students, besides that with digital-based modules, students will be interested in knowing the contents of the lesson being discussed, besides with adding questions with the help of the Adobe Flash application, students are more interested in learning the material.

Evaluation Phase

This evaluation phase can occur at any of the four stages above and is in accordance with the revision needs. At the development stage, product evaluation is carried out based on the suggestions from several validators for improvement, which are listed in the Table 3 below.

Table 3. Validators' Suggestion

Validator	Suggestion	After revision
Validator 1	A glossary should be made	There is a glossary in the revised module
	Improve writing	The writing is in accordance with the grammar
Validator 2	Improve writing and punctuation	The writing has been improved and in accordance with the grammar rules
	Questions of discussion and evaluation should be added with story problems	Questions of discussion and evaluation include story problems related to daily life
	It is better to include the benefits and origin of the relation function	There is the biography and benefits or learning lesson material on relations and functions both in the classroom and in everyday life's context
Validator 3&4	No suggestion	-

Furthermore, the evaluation phase is also carried out during the reflection on the implementation of learning using a digital module and revision of the digital module based on the results of reflection on the implementation. Obstacles that occur during the learning process are because this learning media is new to students, some students focus on experimenting with digital modules so that they do not pay attention to teacher's instructions. The application of technology is an important factor for improving student learning outcomes, but the main factor is still the learning and teaching process (Nadiyah and Faaizah, 2015). For further development the digital module will be designed to support on mobile phones. This is done so that students are free to learn wherever and whenever they want. When in classroom students are more focused on learning. Besides that, the number of laptops provided is still limited, so there are some students who passively pay attention to the lesson. Barriers to the learning

process not only come from students, but also teachers. In the implementation process the class teacher acts as an observer, but has not been able to develop the digital module further. Therefore, further training is needed so that teachers can make their own module according to students' needs and material. This digital module cannot be a single evaluation instrument, so if you want to evaluate students' achievement there must be a companion instrument.

CONCLUSION

The learning media or the digital module that has been developed is in accordance with the students' needs. The digital module becomes an alternative source of learning which is interesting, not monotonous and new. The digital module that has been developed is very valid based on the evaluation of four validators. After implementing learning using a digital module, students respond positively, and it can provide encouragement to the students to develop their mathematical knowledge. Some obstacles experienced by students in using digital module include the lack of focus on what is explained by the teacher. Therefore, for further development there needs to be innovations such as making the digital module support on mobile phones. This is done so students can learn the material first at home and try all the features contained in the digital module. When they come to class, they have more discussion with the teacher. As for teachers, the development of the digital module provides stimulus to develop on other topics. The results of this study provide recommendations that there is a need for quantitative research to test the effectiveness of the use of digital modules in the classroom.

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DESIGNING DIGITAL TEACHING MODULE BASED ON MATHEMATICAL COMMUNICATION SKILL IN RELATION AND FUNCTION

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