Morndumath Application Against HOTS in Building Materials for Middle School Students

Utin Desy Susiaty [a,1,*], Nurul Fitria [b,2], Marhadi Saputro [b,3]

[a] Faculty of Mathematics and Education, IKIP PGRI Pontianak, Pontianak 78116, Indonesia
[b] IKIP PGRI Pontianak, Jl. Ampera No. 88, Pontianak 78116, Indonesia
[1] d3or4f4ty4@gmail.com*; [2] endangsumantri081112@gmail.com; [3] marhadi.mat09@gmail.com
* Corresponding Author

ABSTRACT

This study aims to produce Morndumath application learning media on Higher Order Thinking Skills (HOTS) in building materials for class VIII SMP Negeri 1 Sungai Kakap students who reach the level of validity, practicality, and effectiveness. This study uses the ADDIE development design model, which consists of five main stages, namely analysis, design, development, implementation, and evaluation. The subjects in this study were eighth grade students of SMP Negeri 1 Sungai Kakap. The instruments used in this study were validation sheets, questionnaires, and pretest posttest questions. Based on the results of the first study, the validation of the Morndumath application against HOTS was with the average value of the three experts of 85.25% in the very valid criteria with the very good category. The second is the value of practicality, seen from the value of the questionnaire filled out by the teacher and all students who were accumulated so that a percentage of 87.61% was obtained with very practical criteria. Furthermore, the effectiveness, seen from the results of statistical tests using the pretest and posttest scores of students with t-test results, namely − t-count < - t-table significant = 5% (α = 0.05). This means that there is an increase in the value of student learning outcomes in high-level abilities, so the Morndumath application is categorized as effective.

1. Introduction

One of the fields of education that is important to learn in mathematics. Mathematics can improve thinking skills and is closely related to problem-solving in everyday life. However, the current problem is that students have difficulty mastering mathematics. This can be seen from the low percentage of student graduation in the National Examination (UN), and the factor that causes students to fail is the relatively low mathematical ability of students (Susanto 2013). Learning mathematics is said to be successful if the objectives of learning mathematics are achieved. The purpose of learning mathematics for students is so that students can solve mathematical problems based on critical, logical, and rational thinking processes (Jamaris 2014). However, in reality, there are often cases where students find it difficult to find solutions to mathematical problems. One of the causes of students' difficulties in finding solutions to mathematical problems is the lack of students' ability to think.

The habit of thinking low order or low order thinking that is taught to students causes students not to have higher order thinking skills. One of the thinking skills that must be possessed by students is the ability to think higher order or higher order thinking skills. The thought process is a process that is carried out by a person in recalling knowledge that has been stored in the brain's memory for a time to be used in receiving information, processing, and concluding something. Higher-order thinking skills are the ability to connect, manipulate, and transform knowledge and experience already possessed to think critically and creatively in an effort to make decisions and solve problems in new situations (Widyastuti 2015).

Currently, the government has prioritized learning with high-level thinking competencies or commonly called HOTS (Higher Order Thinking Skills). High Order Thinking Skills are the

ability to connect, manipulate, and change knowledge and experience that is already owned critically and creatively in determining decisions to solve problems in new situations (Dinni 2018). Lewis & Smith (Sara, et al. 2020) stated that HOTS is the ability of skills that students have after receiving information to be able to produce new information. The government's efforts to overcome the low level of higher-order thinking skills of students by making improvements to the 2013 curriculum that are tailored to the needs of students to think at higher levels, equip teachers with an understanding of HOTS to increase teacher understanding and contribution in improving competencies, strategies for using devices, and strategies. implementation of high-level ability-oriented learning (Kemendikbud 2017). Susiaty and Oktaviana (2019) added that the ability to think logically, analytically, systematically, critically, and creatively is a high-level thinking ability or known as Higher Order Thinking Skills (HOTS). (Ernawati 2016) said that HOTS-laden learning has been listed in the core competencies in the SMP/MTS curriculum structure, namely core competencies 3 and core competencies 4. These competencies require students to master HOTS when facing a problem.

HOTS-charged learning can be done by focusing the active learning process on students. Based on Bloom's taxonomy theory, students' high-level skills can be known through the cognitive domain of students' ability levels in analyzing, evaluating, and creating (Anwar 2017). Fanani (2018) adds that Higher order thinking skills (HOTS) or higher order thinking skills are part of Bloom's revised taxonomy in the form of operational verbs consisting of analyze (C4), evaluate (C5) and create (C6) which can be used in the preparation of questions. Teacher creativity and innovation are needed to provide solutions so that HOTS learning can be implemented (Retnoasih 2018). Hasyim and Andreina (2019) stated that High Order Thinking Skill (HOTS) as described by is a thinking skill that is more than just memorizing facts or concepts. Learning with HOTS content must be owned by students so that students not only know the material that has been delivered but students can also apply their knowledge in life (Karsono 2017). Budiman and Jailani (2014) train students to be skilled. This can be done by teachers by training questions with HOTS characteristics.

Basically, the success of a student's learning can be seen from how students are able to analyze, evaluate, and create or find a solution to the problems they face, both in the learning process and activities outside the learning process. Based on the results of an interview with a class VIII mathematics teacher at SMP Negeri 1 Sungai Kakap, that students' ability to solve high-level ability questions or HOTS is still low. Researchers tried to give questions of higher-order thinking skills to students to check and strengthen the results of interviews with the teachers concerned. The material that will be developed in this research is spatial structure because based on the results of interviews with mathematics teachers, the material for geometric shapes is quite difficult for students to understand compared to other materials.

It turns out that the results show that students' higher order thinking skills are still low. This is due to the difficulty of students in analyzing, evaluating and creating or finding a solution to the given problem so that the problem solving plan is also not appropriate.
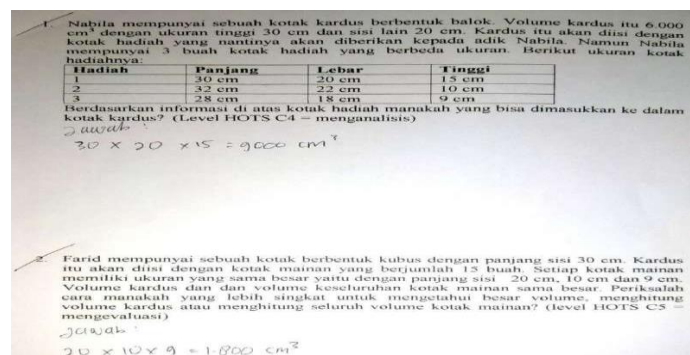

Fig. 1. Students' Work Step 1

Based on Figure 1, it can be seen that students have difficulty in solving problems, students are not able to analyze what information is known from the questions, then students also do not

evaluate the existing problems of the questions and also students have not been able to find the right solution to the problem so that the calculations made by students the result is wrong.
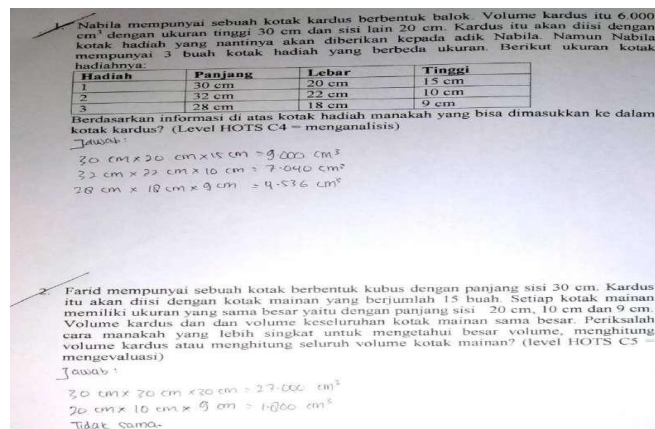

Fig. 2. Students' Work Step 2

Based on Figure 2, it can be seen that students have difficulty in solving questions, students also do not analyze what information is known from the questions, students have evaluated the existing problems from the questions but the evaluation results are not correct in working on the questions so that the results of calculations made by students are wrong. From the two pictures, it is clear that students are still not skilled in high-level abilities, and there are still students who have not been able to analyze, evaluate and create or find a solution to a problem they face.

From the results of the pre-research, it can be concluded that most of the students are less skilled in higher order thinking skills or HOTS. Of course this is not in accordance with the expected goals. One way that can be used to improve higher-order thinking skills is the assistance of learning media used in the learning process, because the use of learning media is also very influential on students. Arsyad (2017) says that learning media is a medium that carries messages or information for instructional purposes or contains teaching purposes. According to (Khairani and Febrinal 2016) learning media is a factor that supports the success of the learning process in schools because it can help the process of delivering information from teachers to students or vice versa. Learning media has an important role in teaching and learning activities, namely being able to clarify the presentation of messages and information conveyed by the teacher, directing and increasing student attention, as well as activating and improving the quality of learning. In addition, learning media can also be used by students as a means of independent learning or with other students without the presence of a teacher.

Almost every subject uses multimedia as an auxiliary or supporting media in the learning process (Susiaty and Oktaviana 2018). Magdalena et al. (2021) added that the media as one of the components in the system, has a function as a means of non-verbal communication. As a component of the system, it means that the media absolutely must exist or must be used in every learning. It is said so because if one of the components is not present then the results obtained will not be maximal. Multimedia is a new technique in the computer field that combines more than one media in a form of communication that includes text, sound, graphics, animation and video into a computer system (Suryanti et al, 2021). Furthermore, Zaki and Yusri (2020) state that learning media are everything that can channel messages, can stimulate the thoughts, feelings, and willingness of students so that they can encourage the creation of a learning process in students. Besides being able to use the available tools, teachers are also required to be able to develop skills in making learning media that will be used if the media is not yet available.

There are many types of learning media that can be developed to improve students' higher thinking skills in mathematics, including the use of Morndumath (M-Learning Educational Mathematics) applications. Mobile learning is part of e-learning as a learning system that utilizes mobile electronic and digital devices (Samsinar 2020). Rahmawati and Mukminan (2017) say that the expected results after using m-learning are learning outcomes that are increasing. Furthermore, Widhoasih added that M-Learning indeed cannot replace direct learning with face-

to-face in class, but rather as a complement to learning and provides opportunities for students to relearn material that is not understood anywhere and anytime. Of course, the use of M-Learning must have careful planning before being applied, so that KBM continues to run optimally (Sasmito et al. 2021). Media development in the form of mobile learning can meet the criteria for learning objectives and content, suitability to student characteristics, learning time efficiency, and easy to use by students (Junita 2019). Furthermore, Pangalo (2020) revealed that the development of mobile learning was shown to be able to be operated on smartphones. The application of information and communication technology in learning has become a must, because the application of information and communication technology is one indicator of success in learning.

The choice of the Morndumath application to be developed is because the Morndumath application can convey information clearly, contains text, images, videos and color displays that can attract students' attention. The Morndumath application is a learning resource that can be used to attract students' interest and attention, learning media that adopts the development of cellular technology and mobile devices (HP). Along with the rapid development of information and communication technology, learning media need to follow the flow of technological modernization, namely by being developed into a digital learning media based on the Morndumath application. Therefore, the development of the Morndumath application is needed to train and develop student learning methods to be able to study independently and actively so that learning objectives can be achieved.

Based on the description, the researchers intend to develop learning media in the form of Morndumath applications for Higher Order Thinking Skills (HOTS) with the chosen research title being "Design Morndumath Applications to Higher Order Thinking Skills (HOTS) in Building Materials for Class VIII Students of SMP Negeri 1 Sungai Kakap".

2. Method

2.1. Research Methods and Design

The research method used in this research is research and development methods. Research and development methods or in English Research and Development are research methods used to produce certain products, and test the effectiveness of these products (Sugiyono 2016). The research and development method used in this research is to create a product that has been tested for its feasibility in helping students understand the learning material.

The research design used in this R&D research is the ADDIE development model, which is a development model consisting of five stages consisting of Analysis (analysis), Design (design), Development (development), Implementation (implementation) and Evaluating (evaluation). The research and development design in this study is described as follows.
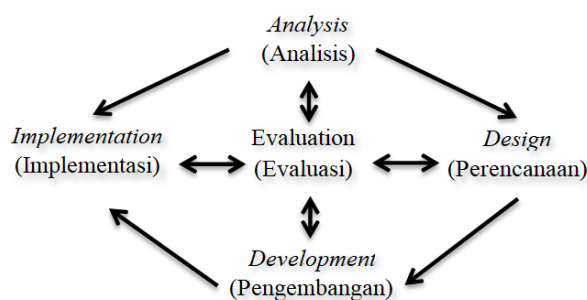
Fig. 3. ADDIE Development Design (Hamzah 2014)

2.2. Research Subject

The subjects in this study were divided into two, namely, the subject of development or experts and the subject of product trials. The division of the research subjects is as follows: (1) the subject of development (experts), namely the experts referred to in this study are experts or experts who validate products known as validators. The products referred to in this study are

Morndumat Applications; (2) the subject of the product trial, namely the eighth grade students of SMP Negeri 1 Sungai Kakap. The sample selection method uses purposive sampling.

2.3. Research Procedure

This research procedure uses the ADDIE development model, which is a development model consisting of five stages consisting of Analysis (analysis), Design (design), Development (development), Implementation (implementation) and Evaluating (evaluation). The procedures are as follows: (1) The analysis phase is carried out to study the problems faced by teachers in determining alternative learning media to be developed. Analysis of student needs which includes the needs and abilities of students who will be the target users of the Morndumath application; (2) the next stage is the design or product design stage; (3) making the Morndumath application using three applications, namely Power Point as a medium for product design, iSpring which is used for making quiz questions that will be loaded in the Morndumath application as a reinforcement of students in understanding the material, and Web2Apk as an application that will convert it into an android application. which will later be installed on the student's android; (4) after the product design is improved then it is realized in real media. The initial trial was carried out with a limited subject simulation. At this stage the media was tested on 8 grade VIII students of SMP Negeri 1 Sungai Kakap. At this stage, a questionnaire was also distributed to measure and find out the opinions or responses of students regarding learning media in the form of applications for learning mathematics about building space. If necessary, revisions will be made based on input and suggestions from students. However, in this revision, input and suggestions from previous validators will be considered so that they do not conflict with previous improvements; (5) evaluation of the product is carried out at each stage of development by researchers, supervisors and validators by providing suggestions for improvement so that the products developed are better. Evaluations were also carried out by students and teachers through the questionnaires they filled out, but by considering suggestions from previous validators on application learning media.

2.4. Data Collection Techniques and Tools

The data collection techniques used in this study are as follows: (1) in this study, the purpose of indirect communication is to see the validity and practicality of the Morndumath Application learning media developed. The media used in this collection are in the form of a questionnaire; (2) in this study, the purpose of the measurement technique is to determine the effectiveness of the Morndumath application containing the Higher Order Thinking Skill (HOTS) developed. The measurement technique used is to use a test in the form of questions containing Higher Order Thinking Skill (HOTS).

2.5. Data Analysis Technique

The main problem in this research can be answered by describing the design process for developing the Morndumath application on Higher Order Thinking Skill (HOTS) in building materials for class VIII students of SMP Negeri 1 Sungai Kakap in general. Meanwhile, the sub-problems can be answered as follows: (1) the validity is obtained from a qualitative assessment by the expert (validator) on the application of Morndumath to Higher Order Thinking Skill (HOTS) in spatial material. The expert gave the assessment to the material and media validation instrument, while quantitative data was used to process data from the validation instrument using a Likert scale consisting of five criteria; (2) practicality is obtained by changing the results or scores of the Morndumath application response questionnaires into the form of practicality percentages; (3) the effectiveness of the Morndumath application was obtained by using a statistical test with paired sample t-test.

3. Results and Discussion

3.1. Research result

Learning media can be said as learning aids, namely everything that can be used to stimulate the thoughts, feelings, attention and abilities or skills of students so that it can encourage the learning process. One form of learning media developed is the Morndumath application for Higher Order Thinking Skills (HOTS). The use of this media is focused on learning activities. The first stage in this research and development is the needs analysis stage by conducting pre-

research at SMP Negeri 1 Sungai Kakap. The results of this analysis will become a reference in developing Morndumath application learning media on Higher Order Thinking Skills (HOTS). The results of the pre-research conducted by researchers at SMP Negeri 1 Sungai Kakap, which in the learning process is still minimal in the use of learning media, the learning media used in learning are worksheets and textbooks which are still less attractive to students' curiosity about learning materials, in addition to The curriculum used in SMP Negeri 1 Sungai Kakap is the 2013 curriculum (K13) where K13 requires teachers to be able to combine learning with the help of technology. Therefore, researchers think to develop new and more interactive learning media and attract students' interest and curiosity about the learning material being taught.

The planning stage is a follow-up to the analysis stage. In the learning media planning process, a design sketch is needed to help make learning media. The sketch is poured into a storyboard. Learning media using power point software developed by the researcher contains 16 frames consisting of the title page frame, main menu frame, guide frame, KD and GPA frames, material frames, sample questions frames, learning video frames, quiz frames, and frames. info. Based on the storyboard it can be presented in Figure 4.

Fig. 4. Morndumath Application Storyboard

In this development stage, several things were done, namely: (1) the media that had been designed by the researcher was then created and developed. This media was developed using Power Point, Ispring and Web2Apk. The contents of this learning media consist of materials obtained from several Mathematics books for class VIII Curriculum 2013; (2) the validation process is carried out by 3 validators who understand the preparation of Morndumath application learning media and are competent in their fields, namely two mathematics study program lecturers and one ICT education study program lecturer and one mathematics teacher. Suggestions from the validator are used as input to revise the Morndumath application so that the Morndumath application is valid and ready to be implemented to class VIII students of SMP Negeri 1 Sungai Kakap as research subjects. Based on calculations from the validation of material experts and media experts, the level of validity of the Morndumath application used to answer the first problem formulation is shown in Table 1.

Table 1. Average Expert Validation Results

No	Expert	Evaluation (%)	Criteria
1	Material Expert	85,40%	Very Valid
2	Media Expert	85,10%	Very Valid
	Average	**85,25%**	**Very Valid**

Table 1 shows that the level of validity of the Morndumath application learning media on Higher Order Thinking Skills (HOTS) in building material for class VIII students of SMP Negeri 1 Sungai Kakap has very valid criteria with an average percentage of 85.25%.

At the implementation stage, it was only carried out at the limited trial stage because the circumstances did not allow it to carry out large-scale trials. The schools selected were schools that had the same accreditation and had the same student characteristics, namely SMP Negeri 1 Sungai Kakap. What is being tested at this stage is the application of Morndumath against valid HOTS. The purpose of conducting this trial is exactly the same as the scheme of large-scale field trial research, among others, to see the feasibility of Morndumath application when applied to class VIII students.

The results of product trials carried out in this study are as follows: (1) The practicality of the Morndumath application can be seen from the results of the teacher and student response questionnaires. The practicality assessment was filled out by the teacher of SMP Negeri 1 Sungai Kakap and 8 students of class VIII regarding their response to the Morndumath application that had been used during the learning process. The results of the teacher response questionnaire and student response questionnaires to the Morndumath application are presented in Table 2.

Table 2. Practicality of Teacher and Student Response Questionnaires

No	Aspect	Evaluation (%)	Criteria
1	Teacher's Response	89,60%	Very Practical
2	Student Response	85,63%	Very Practical
	Average	**87,61%**	**Very Practical**

Based on Table 2 the percentage of teacher and student indexes, the percentage value of practicality of 87.61% is included in the very practical criteria. (2) In this study, effectiveness was measured using statistical tests. The results are as follows: (a) the normality test was carried out to answer the research hypothesis which was analyzed using the Liliefors formula to see whether the data obtained from the pre-test and posttest results were normally distributed.

Table 3. Normality Test Results of Pretest and Posttest

Normality		N	χ^2 Count	χ^2 Table	Decision test	Conclusion
Experiment	*Pretest*	8	0,193	0,285	H_0 received	Distribute Normal
	Posttest	8	0,159	0,285	H_0 received	Distribute Normal

Based on Table 3, it can be concluded that the pretest and posttest data came from a normally distributed population. (b) Hypothesis testing was carried out to determine whether there was an increase in students' mathematical understanding abilities after using the Morndumath application on Higher Order Thinking Skill (HOTS) in the material of building space in class VIII students of SMP Negeri 1 Sungai Kakap. Based on the normality test above, the result is that the data is normally distributed, then proceed with the parametric test using the t-test. The results of the t-test are presented in Table 4.

Table 4. T-Test Results

	Before	After
Average	40,625	88,28125
Variant	345,9821429	83,0078125
Lots of data	8	8
Coefficient correlation	0,971399072	
Df	7	
t count	-13,49617921	
t table	2,364624252	

Conclution: $t_{\text{count}} < - t_{table}$ **then there is an increase in the results of students' higher-order thinking skills between before and after being given learning with the Morndumath application**

Based on Table 4, it can be concluded that the Morndumath application is effective because there is an increase in the value of students' higher order thinking skills between before and after

being given learning with the Morndumath application on Higher Order Thinking Skills (HOTS) in building material for class VIII students of SMP Negeri 1 Sungai Snapper so that the Morndumath application can be used as a learning medium.

After a limited trial has been carried out, the Morndumath application for HOTS is ready to be packaged into a final product. The mathematics teacher at the test site did not give any suggestions. He only thinks that the Morndumath application for HOTS can facilitate the teaching and learning process and can help students to have the ability to understand concepts and apply these concepts according to the problems students face in everyday life, especially in building cubes and blocks. Thus, the Morndumath application for HOTS can be transferred back via links with supporting platforms such as Share It, Google Drive, and WhatsApp and installed offline.

3.2. Discussion

The development of learning media for the Morndumath application on Higher Order Thinking Skill (HOTS) in spatial construction for class VIII students of SMP Negeri 1 Sungai Kakap using the ADDIE research procedure was adapted from the summary of activities of the ADDIE Dick and Carry model (Sugiyono 2016). The ADDIE model consists of five stages, namely 1) Analysis, 2) Design, 3) Development, 4) Implementation, and 5) Evaluation. The analysis phase aims to learn what problems are faced by teachers and students so that researchers have solutions to these problems. The design stage aims to make an initial design of the product that will be developed according to the needs in the field. The development stage aims to realize the product design that was previously made at the design stage. The implementation phase aims to obtain feedback on the developed product, where the developed product is implemented on a subject to obtain feedback. The evaluation stage aims to provide feedback to product users, so that revisions are made according to the results of the evaluation or needs that have not been met by the product.

In Nieevan's opinion (Kurniawan 2019) that in addition to producing a product in carrying out development research, you must also pay attention to the quality of the product produced through testing the level of validity (validity), practical (practical), and effectiveness (effectiveness) of the resulting product. By knowing the quality of the resulting product, the resulting product can be used in a wider environment by following per under the purpose of its manufacture. In this research, the product produced is a learning media in the form of Morndumath application to Higher Order Thinking Skill (HOTS) in building material.

The validity of the Morndumath application is known through the validation stage by material experts as well as media experts who use a Likert scale and use a range of "81-100% indicating very valid criteria" Widoyoko (Indrayanti and Masriyah 2016). Analysis of the validation of the Morndumath application by the material obtained an average percentage of 85.40% with very valid criteria so that the Morndumath application is feasible to use. The media expert validation sheet for the Morndumath application obtained an average percentage of 85.10% with very valid criteria so that the Morndumath application was feasible to use. The results of the calculation of media experts and material experts obtained an average percentage of 85.25% with very valid criteria, so that the developed Morndumath application can be used very well in the learning process.

After completing the validation, the next step is product testing. This product trial aims to determine the practicality of the developed Morndumath application and to determine the effectiveness after using the developed Morndumath application. To find out the practicality, the average response from students for the practicality of the Morndumath application was 85.63% with very practical criteria involving 8 grade VIII students of SMP Negeri 1 Sungai Kakap. Meanwhile, the teacher's response questionnaire obtained a percentage of 89.60% with very practical criteria. From the student and teacher response questionnaires, an average practicality value of 87.61% was obtained with very practical criteria.

To find out the effectiveness of the Morndumath application, it is done by giving a pre-test and post-test which contains 4 questions. The question was given to the same subject, namely 8th grade students of SMP Negeri 1 Sungai Kakap. After getting the pre-test and post-test results, the scores were calculated using statistical tests to test the effectiveness of the Morndumath application. From the results of statistical tests, it was concluded that H0 was rejected, which

means that there was an increase in the value of student learning outcomes in higher order thinking skills or HOTS, so that the Morndumath application was effective.

The results of this study are also in line with research conducted by Sinaulan P.I Yanse and Luckie Sojow (2019) the results of android-based learning media obtained the results of research on the validity of this learning media of 94.57%, so it is included in the very feasible category. The result of this android-based learning media practitioner is 89.52% so it is included in the very feasible category. The student's response to this media when the trial was carried out on average showed a positive response by getting a percentage of 90%. Thus, this Android-based Multimedia Design learning media is feasible to be used as a medium.

The Morndumath application in collaboration with higher-order thinking skills or commonly called HOTS can improve the abilities of students in high-level abilities including students being able to analyze, evaluate and create a solution to the problems they face. In addition to some of the things that have been described in this research, there are also some limitations. The limitations in the research and development of Morndumath application media based on the research that has been carried out are as follows: (1) limitations in conducting research, among others, the media produced is still included in the beginner level development which only includes one basic competency with building material; (2) the determination of media eligibility standards is limited to aspects of material, language problems, implementation, software, and learning design; (3) the trial of the implementation of the media in only one school, namely SMP Negeri 1 Sungai Kakap class VIII as many as 8 students due to the covid-19 pandemic which made it impossible to test on many test samples.

4. Conclusion

Based on the results of the research and discussion that have been described previously, in general it can be concluded that the development of the Morndumath application for Higher Order Thinking Skills (HOTS) in the material of building space for class VIII students of SMP Negeri 1 Sungai Kakap, using the ADDIE design model which consists of five stages. namely Analysis, Design, Development, Implementation, and Evaluation are classified as good to use. The conclusions from this study are as follows: (1) the level of validity of the application of the Higher Order Thinking Skill (HOTS) in the material of building space for class VIII students of SMP Negeri 1 Sungai Kakap is categorized as very valid; (2) the level of practicality of the application of Higher Order Thinking Skill (HOTS) in building materials for class VIII students of SMP Negeri 1 Sungai Kakap is categorized as very practical; (3) there is a positive and significant effect on the use of learning media on Higher Order Thinking Skills (HOTS) in spatial building materials for class VIII students of SMP Negeri 1 Sungai Kakap, which is indicated by an increase in the value of students' higher order thinking skills between before and after being given learning with the Morndumath application so that the Mordumath application is categorized as effective.

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