



Development of sign language videos to improve mathematical communication of deaf students of fractional material

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Abstract: As many as 7.03% of people with disabilities in Indonesia are deaf people. The problem for deaf students is the lack of mathematics learning resources during learning and the low mathematical communication skills of deaf students. The purpose of this study is to analyze the development of sign language learning videos to improve mathematical communication of deaf students of fractional material in terms of validity, practicality, and effectiveness. The method used is the R&D method with a 4D model. The results showed that the validity of the media resulted in a very valid category by sign language experts with a score of 85% and material experts with a score of 83% and categories valid by media experts with a score of 78.5%. The results of media practicality of 100% for teacher and student responses and learning implementation questionnaires are said to be very practical. The results of the control class pretest and the experiment resulted in a sig value. > 0.05 , then the data is normal. Homogeneity test with $F_{count}(6,14) < F_{table}(19)$ on pretest questions and $(4,68) < F_{table}(19)$ on posttest questions then homogeneous data. Student scores resulted in a difference in the average student learning outcomes between the experimental class and the control class indicated by the T test results with the sig value. $(0.001) < 0.05$. The average value of the N Gain of the experimental class is greater than that of the control class, which is 0.9721 with a high category. so that the media is said to be valid, practical, and effective.

Keywords: Deaf students; Fraction; Learning videos; Mathematical communication skills; Sign language

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INTRODUCTION

Mathematics is a basic subject that influences the development of technology to be more advanced, mathematics plays an important role in the development of human thinking power (Putut, 2017). Therefore, it is important to teach mathematics to students from elementary to high levels, including students with special needs who also have the right to obtain mathematical knowledge. Mundia (2010) explained that there are many mathematical functions that can be used in various situations and everyday problems. The implementation of the teaching and learning process will have an impact on the quality of students. The implementation of learning must be effective, efficient, and meaningful so that the knowledge learned can be absorbed properly (Lestari et al., 2022). One type of student with special needs is deaf. Deaf people are not very able to hear or cannot hear at all and have difficulty communicating orally (Gunawan, 2016). According to Nofiaturrehman (2018) in terms of formal non-lessons, the development of deaf students is as good as that of normal students. Deaf



students are better able to receive material by using sign language lecture methods, writing, and speech/oral methods (Hidayat & Suherman, 2016).

Hidayat & Suherman (2016) said the mathematical communication skills of deaf students fall into the very low category. Deaf students are only able to correctly express the epitome of mathematics but are unable to write down and explain the solving of the problem and what conclusions were obtained. Nurhanifah (2021) said that the ability to receive information of deaf students lags far behind compared to students who can hear. Based on the results of the pretest with question indicators about students' mathematical communication skills. The average score of the initial test for students of SLB-B YPPALB Kota Magelang at the junior high school level was 23.75 out of 100. So that the mathematical communication skills of SLB-B YPPALB Magelang city students are very low. The results of the needs analysis at SLB-B YPPALB Kota Magelang fractional material are considered difficult by students. Teachers of SLB-B YPPALB Kota Magelang said that the use of books and LKS is the main medium used in the student learning process. In accordance with the results of observations, students find it difficult to understand the material provided.

Komariah & Sundayana (2017) said that learning methods are the cause of the difficulty of the student's mathematics learning process. If the method chosen is right, it can make students enthusiastic when participating in learning. according to Kusumawardhani (2020) audio-visual media and multimedia-based media are included in the classification of innovative learning media for students with disabilities. Deaf students are the main users of sign language, by combining limbs and facial mimics when communicating. Based on the results of the questionnaire for the analysis of learning media needs at SLBB YPPALB Kota Magelang, 9 out of 12 students chose learning videos as a tool needed when learning mathematics. Based on the background above, the development of a sign language learning video in accordance with student understanding entitled "Development of Sign Language Learning Videos to Improve the Mathematical Communication Skills of Deaf Students on Fractional Material".

The purpose of this study is to analyze the development of sign language learning videos to improve mathematical communication of deaf students of fractional material in terms of validity, practicality, and effectiveness Relevant researches related to this research are Research by Putri, et al. (2019) which produces learning videos with sign language based on effective character education to increase the learning motivation of grade V students at SDLB-B Negeri Buleleng for the 2017/2018 academic year. Research by Putra, Suarsana, & Suharta (2020) which produces interactive teaching materials for fractional materials meets the criteria of valid, practical, and effective. Solihah & Suparman (2019) with the results of the study stated that the finding of mathematical communication skills of students is still low and students like learning with the use of multimedia as a learning resource, but the learning resources used by teachers have not been able to improve or stimulate students' mathematical communication skills, so multimedia learning is needed that can stimulate students' mathematical communication skills.

METHOD

The research and development method commonly referred to as Research and Development (R&D) is the method used in this study. The R&D method is one type of research method that focuses on product development and feasibility testing of products that have been developed. According to Sugiyono (2019) research and development functions to verify and develop certain products. The product in question is not only limited to objects such as textbooks and films, but also teaching methods. The model used in this study is a 4D. The 4D model was developed by Thiagarajan, Dorothy, and Melvyn (1974: 5). The 4D development model consists of 4 main stages, namely define, design, development and disseminate.

Define

The Define stage is to analyze 5 activities carried out, namely as follows.

Front-end Analysis

The final preliminary analysis aims to find out the fundamental problems in the school and students. This stage will find facts and other ways as problem solvers to make it easier to determine the initial steps of developing the right media.

Learner Analysis

That is aimed at knowing the quality of students including characteristics, skills and things that students do as a group or individual. In addition, it also aims to find out how high / low the mathematical communication of students at SLB-B YPPALB Kota Magelang at the junior high school level. It is carried out by giving a pretest of fractional material whose questions have met the student's mathematical communication indicators. The mathematical communication indicators used in this study are as follows.

- a. Explain and express thoughts about mathematical ideas in writing as well as speech.
- b. Express and reflect real objects, situations and everyday events into the form of mathematical models.
- c. Using mathematical language/notation appropriately in various mathematical ideas

Task Analysis

This activity has the aim of identifying important tasks that will later be completed by students by analyzing core competencies (KI) and basic competencies (KD) related to the material on the media to be developed, namely sign language learning videos.

Concept Analysis

In this step, the content of the material for the media will be determined so that it can be used in the achievement of certain competencies. This step is also carried out in a structured preparation of the material.

Specifying Instructional Objectives

The next step is to determine the learning objectives in order to know the content of the media to be developed. In this step, a grid of questions is also made to find out the achievement of learning.

Design

Design stage is the design of learning tools from what has been found in the previous stage (define) is what is done at this stage of design. There are 4 activities at the design stage according to Thiagarajan (1974: 7) which are as follows.

Compile Criterion-test construction

This stage is the phase of compiling a criteria test as a preliminary analysis so that the feasibility of the media can be measured, as well as an assessment tool to measure how successful the media developed when used directly to students and the extent of the ability to be achieved.

Media Selection

That is the selection of media that is in accordance with the characteristics of the students. Based on the analysis of student characteristics, the media to be developed is in the form of sign language learning videos.

Format selection

This stage is carried out to design and organize the content of sign language learning videos, make sign language learning video designs in accordance with the storyboard.

Initial design

This stage is carried out by designing sign language learning videos, then given input by the supervisor. The input will be used to enhance the learning video before it is validated by experts. This design is in the form of draft I of a sign language learning video.

Development

The Development stage aims to produce a draft II of sign language learning videos after going through revisions based on input and assessment of media experts, material experts, and sign language experts, as well as teacher and student responses and data on trial results. The development stage includes two activities, namely as follows.

Expert Appraisal

This stage is carried out validation / assessment of draft 1 by experts in their fields who in this case are called validators. The assessment contains an evaluation from validators in the form of input so that the content and design of the learning video that has been made can be refined. After draft I has been assessed and revised, draft II is produced, which will then be tested on students in the next step.

Product Trial (Developmental testing)

The product being tested at this stage is draft II. The trial is intended to find out which parts are needed for repairs. The product is improved on responses, comments, and feedback from students and teachers. In this activity, the implementation of tests and product revisions must be carried out so that the product developed has good quality. Field trials were conducted as follows.

a. Field Trials

This activity was carried out on students of SLB-B YPPALB Magelang City at the 8th grade junior high school level as a trial class. This stage is carried out by providing sign language learning videos to students. In addition, students are given pretests and posttests to determine the validity, reliability, difficulty of the questions, and the differentiating power of the question device. Then students are given a response questionnaire for product improvement. In addition to students, teachers can also provide input to products by filling out the teacher's response questionnaire.

b. Final Revision of the Product

After collecting all the data needed, the next step is to analyze the data and make revisions to improve product quality. The results of the trials and revisions at this stage of the field trials will produce the final product.

Dissemination

Dissemination is the final stage carried out, namely the dissemination of products that are proven to be valid so that they can be used more widely and the results of this research will also be published in journals. At this stage, the application of sign language learning videos is also carried out. It aims to measure the effectiveness of learning carried out with the help of sign language learning videos. The application of the product is carried out on students of SLB-B YPPALB Kota Magelang at the junior high school level. The classes used are the experimental class and the control class. This stage is carried out by providing sign language learning videos to students. The population in this study was all students of SLB-B YPPALB Kota Magelang and the sample in this study was all students of SLB-B YPPALB Magelang City at the junior high school level totaling 12 people.

RESULTS AND DISCUSSION

The initial design of the product produces pretest and posttest questions, learning implementation plans, and learning video designs which are hereinafter referred to as draft 1.

The questions in the pretest and posttest used are description questions because according to [Hodiyanto \(2017\)](#) the provision of description questions in mathematics learning will be able to reveal students' mathematical communication skills. The test of the validity of the question instrument produces a calculation of 6 questions said to be valid while 4 questions are invalid both pretest questions and posttest questions, then the reliability test is obtained r calculate 0.98 the price is included in the very high criteria.

The validity of sign language learning video media is measured by validating by 9 expert validators. The calculation is carried out manually using the formula of the number of scores of the categorization indicator divided by the number of total scores of the categories which resulted in a score of 85% from sign language experts with very valid criteria, 83% of material experts with very valid criteria, and 78.5% of media experts with valid criteria, so that the product can be said to be valid but still improved according to input from expert validators. Formula to find out the validity according to [Hasanah and Nurfalih \(2020\)](#).

$$P = \frac{\sum x}{\sum xi} \times 100\% \quad (1)$$

which include the percentage score (P), the accumulated indicator scores per aspect ($\sum x$), and the accumulated total score of aspects ($\sum xi$). The validation results are shown in the [Table 1](#).

Table 1. Sign Language Learning Video Media Validation Results by Expert Validators

No	Aspects Assessed	Average Score	Criteria
1.	Language Proficiency	85%	Very Valid
2.	Content	83%	Very Valid
3.	Media	78,5%	Valid
	Overall Assessment	82,17%	Very Valid

In accordance with the calculation of the media validity test, sign language learning videos are valid and are used to improve the mathematical communication skills of deaf students. This is in accordance with [Yuliantuti \(2021\)](#) that to improve student mathematical communication can be done by applying learning videos during learning activities.

The practicality of sign language learning video media is measured through students' responses to the products that have been developed, these results are calculated and scored by 94% without revision. Teacher response with 100% results without revision, and learning implementation questionnaires with 100% results. For the analysis of media practicality according to [Akbar \(2013\)](#) using the following formula.

$$V - au = \frac{TSe}{TSh} \times 100\% \quad (2)$$

which the Audience Validation ($V - au$), Total Expected Score (TSe), and Total Expected Score (TSh).

So that the video media of sign language learning can be said to be very practical. The practicality category of sign language learning videos in this study is seen from the display, operation, and utilization of media. An attractive look can foster the learning motivation of deaf students, this is in accordance with the research that has been done. Students are very enthusiastic when learning using sign language learning videos on fractional material and are active when given practice questions in front of the class. In addition, the operation and utilization of media that is very easy to use makes it difficult for students when opening their media. The data obtained after carrying out learning of the control class and experimental class are the results of pretest scores and post-test value results. The average value is contained in the [Figure 1](#).

Furthermore, the value is calculated to produce the effectiveness of the media which includes a normality test by generating a sig value. for pretest and posttest values in both the control class and the experimental class > 0.05 so that the data is said to be normal. The normality test formula using shapro wilk is as follows.

$$T_3 = \frac{1}{D} \left[\sum_{i=1}^l a_i (X_{n-i+1} - X_i) \right] \quad (3)$$

The value of D can be obtained from

$$D = \sum_{i=1}^n (x_i - \bar{x}) \tag{4}$$

Which the coefficient of the Shapiro-Wilk test (D), the number represented by X_{n-i+1} , the number represented by x_i in the data, and the mean of the data represented by \bar{x} .

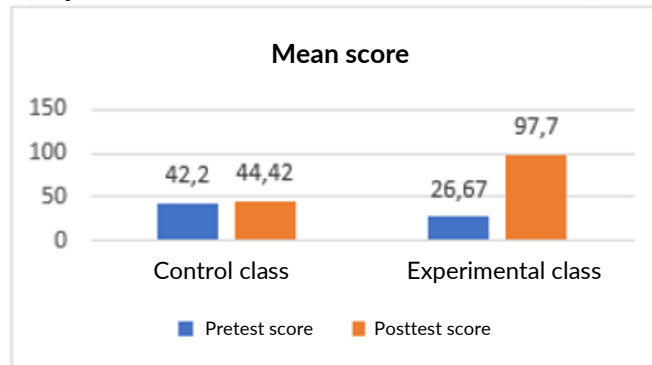


Figure 1. Average Value

Furthermore, a homogeneity test was carried out with a value of $F_{count} (6.14) < F_{table} (19)$ on the pretest question and a F_{count} value $(4.68) < F_{table} (19)$ on the posttest question so that it can be said that the data is homogeneous. The T test returns a sig value. (2 tailed) of $0.001 < 0.05$ so that it can be concluded that there is a difference in the average student learning outcomes between the experimental class and the control class.

The next step is to measure how much improvement in student learning outcomes with the N gain test. The formula N Gain is as follows.

$$N \text{ Gain } (g) = \frac{\text{Posttest score} - \text{Pretest score}}{\text{Ideal score} - \text{Pretest score}} \tag{5}$$

Based on calculations, the average value of the N Gain score for the experimental class is 0.9721 and results in conclusions falling into the high category. While the average score of N Gain score for the control class is 0.038 which results in a conclusion belonging to the low category. The results of the N Gain test showed that there was an increase in experimental class learning outcomes higher than that of the control class. Learning outcomes are said to be effective when the average score of N Gain is at least moderately categorized or more than 0.30 (Ramdani, 2019), so that sign language learning video media can be said to be effective.

Based on the results of the study, students were very enthusiastic when learning using sign language learning videos because the videos were designed with an attractive appearance. Anugerah, Ulfa, & Husna (2020) said that sign language learning videos are visual media that can help and train students to analyze and deduce material delivered through their sense of sight. According to Rahayu (2017) in learning carried out by providing treatment, students seem enthusiastic and focused on observing learning materials because they contain animated elements that are attractively packaged in explaining the material. The use of language that is easy to understand can influence students so that it can help students understand concepts and will have an impact on students' interest in listening to learning videos seriously (Jundu et al., 2020). The media is displayed in the class as shown in Figure 2.

Based on the three mathematical communication indicators in this study, the most improved are the first and third indicators, namely the ability to explain and express thoughts about mathematical ideas in writing as well as speech and the ability to use language / mathematical notation appropriately in various mathematical ideas, the increase can be seen in posttest scores that are higher than pretest scores in learning using sign language videos. In accordance with the research of Anugerah, Ulfa, & Husna (2020) the use of visual media in the form of teaching videos can make students more quickly recognize the shape of objects, namely by looking at images directly and can train students to analyze and conclude, so that students can understand the material presented.



Figure 2. Media Display

The sign language used in the development of this learning video is SIBI because SIBI has been set by the government for use in extraordinary schools (SLB) (Nugraheni, Husain, & Unayah, 2021). Based on the results of the study, the use of sign language in mathematics learning in the classroom is quite good, although the obstacles are still there, but deaf students can use the communication system well during learning by looking at gestures, oral (oral movements) and writing. So that sign language learning videos are very in line with the characteristics of students.

The advantage of this sign language learning video is that it is flexible, can be accessed anywhere and anytime, students can learn the material through learning videos independently without a teacher, and can improve the mathematical communication of deaf students Li, et al. (2020). As Wulandari et al. (2020) said, videos support student-focused learning in and out of the classroom. The disadvantage of this sign language learning video media is that there are words in the video that students do not understand because students understand BISINDO sign language better than SIBI. According to Leman & Rahman (2022) the use of deaf daily cues is guided by SIBI, but the facts on the ground say that BISINDO is the daily language of the deaf. BISINDO is the language of the community between regions, so each region has differences. Learning videos made using SIBI because SIBI has been used as the main language in SLB so that learning videos can be used by all SLB in Indonesia.

CONCLUSION

Based on the presented results, it can be concluded that the utilization of sign language learning video media to enhance students' mathematical communication is both valid and practical. The effectiveness of this approach is evident from the positive impact it has on students' learning outcomes, specifically leading to significant improvements in their academic performance. The findings indicate that incorporating these media resources into the learning process positively influences students' understanding and engagement, ultimately resulting in higher learning outcomes.

The validity of using sign language learning videos can be attributed to the measurable improvements observed in students' mathematical communication skills. By visually representing mathematical concepts through sign language, students can grasp complex ideas more effectively, leading to enhanced understanding and communication. The practicality of this approach lies in its accessibility and ease of implementation, as sign language learning videos can be readily integrated into existing educational frameworks without requiring significant changes or additional resources.

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