

## The Use of Assistive Learning Technology in Learning Mathematics for Hearing Impairment Students

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### Abstract

The problem in this study is the limitations of mathematics learning media that are suitable for the conditions of deaf students. So, the researcher developed an assistive math teaching aid for deaf students. This study aimed to determine the effect of using assistive learning technology given to hearing impairment students. This research focuses on improving the representation ability of hearing impairment students on the topic of fractional operations. This research is a quantitative study with a pretest-posttest control design. This research was conducted on hearing impairment students with mild to severe categories without intellectual impairment. The number of hearing impairment students involved was 12 students at a special type B school in Magelang City, Indonesia. The N-Gain test was used in this study to measure the improvement in the representation ability of hearing impairment students. Based on the results of the study, it was concluded that assistive learning positively affected the representation ability of hearing impairment students. Based on the results of the N-Gain test, an increase of 0.972 was obtained. In addition, the use of assistive learning technology provides a learning experience that trains the independence of hearing impairment students. The teacher's role as a facilitator in the classroom can be maximized because topics can be accessed anywhere and anytime.

**Keywords:** assistive learning technology, hearing impairment, representation

### INTRODUCTION

Hearing impairment people are one who have lost the ability to hear, and it impelled to hamper the process of language information through their hearing (Cook, Polgar, & Encarnação, 2020) (Davison-mowle, Leigh, Duncan, & Arthur-Kelly, 2018). This condition can be temporary or permanent. To communicate with hearing impairment people, special communication is needed so that the purpose of the conversation can be conveyed properly. This communication can be done with sign or oral language or both (Marschark et al., 2013).

A person's condition can be said to be hearing impairment after going through an examination by a doctor with audiometry. Judging from a person's response to sound, the hearing impairment condition can be categorized into several types, namely 1) very

mild hearing loss (27-40 dB), 2) mild hearing loss (41-55 dB), 3) moderate hearing loss (56-70 dB), 4) severe hearing loss (71-90 dB), and 5) severe hearing loss/hearing impairments (more than 91 dB) (Marschark et al., 2013).

In learning mathematics, the hearing impairment condition needs to be accommodated to maximize the ability of hearing impairment students. Characteristics of hearing impairment are divided into three aspects: academic, socio-emotional, and physical/health. The characteristics of hearing impairment in academics are limitations in speaking and language skills so the hearing impairment tend to have low achievements in verbal topics (Marschark & Knoors, 2012). Meanwhile, on non-verbal topics, the ability of hearing impairment students is the same as their peers. In the socio-emotional aspect, the hearing impairment community is limited to

fellow hearing impairment, has a high egocentric, there is a feeling of fear of the surrounding environment, attention is difficult to divert, and feelings are sensitive (Marschark & Knoors, 2012). On the physical aspect, hearing impairment people usually experience balance problems, hand movements are very fast and agile, and eye movements are more rapid.

However, teachers need to facilitate the characteristics of hearing impairment students to minimize students' difficulties in learning mathematics. One of the things that teachers can do is prepare learning media according to their characteristics. Several learning media that have been developed for hearing impairment students are e-learning, courses for hearing impairment students, and videos (Wongkia, Naruedomkul, & Cercone, 2012). In addition, there are other types of electronic learning media, namely assistive learning technology. Assistive technologies are specially made-items or equipment used to enhance and maintain the functional abilities of individuals with disabilities (Wong & Cohen, 2011; Adebisi, Liman, & Longpoe, 2015). Assistive technology is any item that enables persons with disabilities to complete tasks that they would otherwise be unable to do because of their disability (Buehler & O'Brien, 2011).

The problem in this study is the limitations of mathematics learning media that are suitable for the conditions of deaf students. So, the researcher developed an assistive math teaching aid for deaf students. During the Covid-19 pandemic, teachers forced teachers to adapt media to technology and characteristics. There need to be media that can be opened by hearing impairment students anywhere and anytime (Abdallah & Fayyumi, 2016). In addition, interactions also need to be developed to minimize the loss of knowledge transfer (Akpan & Beard, 2014).

The strength of hearing impairment students is their visual ability, namely the movement of their hands and eyes is very agile. In addition, hearing impairment students

are also very focused individuals. These advantages can be used as the main features in the media, so it needs to be strengthened in the preparation of engagement through interaction.

The visual abilities of hearing impairment students allow them to develop their representational abilities faster than regular students (Rosayanti & Mulyono, 2019). Thus, it is necessary for teachers to maximize this ability through appropriate stimulation. One thing that can be done is to minimize the use of language and add information in the form of pictures, tables, diagrams, or the like.

## METHOD

This research is a quantitative study with a pretestposttest control design. A total of 12 hearing impairment students were involved in this study to see the effectiveness of using assistive learning technology in learning mathematics. The magnitude of the increase was tested using the N-Gain obtained from the pretest and posttest scores of the representation ability of hearing impairment students.

The N-Gain test was conducted to determine whether there was an increase between the pretest and posttest scores or not. N-Gain is calculated by the following formula.

$$N - Gain = \frac{Posttest\ score - Pretest\ score}{Ideal\ score - Pretest\ score} \quad (1)$$

The pretest and posttest questions are arranged according to the indicators of representational ability namely, students can illustrate pictures or diagrams and can explain the meaning of pictures. It also includes explaining the correct relationship between the relevant solutions to a problem.

The population in this study were hearing impairment students at a special type B school in Magelang City, Indonesia, a sample of 17 deaf students in junior high school. The hearing impairment students involved were hearing impairment students without intellectual impairment, with mild to severe categories.

The instrument used in this research is a matter of pretest and posttest of representation ability. The research design is shown in the Table 1.

Table 1. Pretest Posttest Control Design

Group	Pretest	Treatment	Posttest
Experiment	O <sub>1</sub>	x	O <sub>2</sub>
Control	O <sub>3</sub>		O <sub>4</sub>

O<sub>1</sub> is a pretest before being given treatment, and O<sub>3</sub> represents pretests in the control group; X symbolizes a treatment in the form of the use of assistive learning technology; O<sub>2</sub> expresses a posttest after being given treatment; and O<sub>4</sub> states a posttest without the use of assistive learning technology.

## RESULT

### Pretest Results in Control and Experimental Groups

The pretest of the control and experimental groups was carried out to see the initial ability of the two classes. In addition, to find out whether the two classes have the same initial ability. Based on the results of the study, pretest and posttest data were obtained, which are shown in Table 2.

Table 2. Pretest Data Homogeneity Test

F-Test Two-Sample for Variances		
	Control	Experiment
Mean	26.6667	42.2
Variance	43.3333	70.63
F count	6.14	
F table	19	
Criteria	F count < F table	
Conclusion	Homogenous	

Based on the data in Table 2, it can be concluded that the control and experimental groups have the same initial ability. The data explains that the condition of the two groups are balanced. This condition is ideal for treatment. Thus, both groups were ready to be given treatment.

### Posttest Results in Control and Experimental Groups

Posttest data were obtained after treatment in the form of learning with assistive learning technology in the experimental group. While the control group was given the treatment of learning mathematics without assistive learning technology. Both of these were carried out on the topic of learning fractions and their operations. The data obtained were tested for normality, homogeneity, and N-Gain. Table 3 is the normality test for the two groups.

Table 3. Normality Test

Represent- ation	Groups	Kolmogorov Shapiro- -Smirnov	
		Stat.	Sig.
	Control	0.220	0.782
	Experiment	0.372	0.986

The data criteria are categorized as a normal distribution, that is, if the value of Sig. > 0.05. Notice in Table 3, the value of Sig. on the Shapiro Wilk section so that it can be concluded that the data of the two groups are normally distributed.

Furthermore, the posttest data were tested for homogeneity in both groups. The homogeneity test aims to see the level of homogeneity of the control and experimental classes. The data come from the same population and have the same level of variance. Table 4 is the results of the homogeneity test for the control and experimental groups on the posttest data.

Table 4. Homogeneity Test of Two Groups  
Posttest Data

Value Type	Control	Experiment
Variance	70.085633	14.96333
F count	4.68	
F table	19	

The criteria for data categorized as homogeneous is the calculated F value < F table, which is 4.68 < 19. So, the data can be said to be homogeneous.

Furthermore, the effectiveness of providing assistive learning technology is measured through the N-Gain test. N-Gain is useful for measuring the magnitude of the increase in value before and after learning with assistive learning technology. Table 5 is the result of the N-Gain calculation of the control and experimental groups.

Table 5. Result of N-Gain Calculation of Control and Experiment Group

No	Group	N-Gain Score
1.	Experiment	0.972
2.	Control	0.038

Table 5 provides information that the N-Gain score in the experimental group is higher than the control group. The experimental group increased in the very good category, namely 0.972.

In the H5P-based interactive sign language video using SIBI sign language which can help students communicate. H5P-based sign language interactive videos were made using SIBI sign language, because SIBI is the main language in SLB, so this interactive video can be used by all SLB in Indonesia. Because the SIBI sign language has been established by the government for use in SLB (Nugraheni, Husain, & Unayah, 2021).

## DISSCUSSION

Based on the results of the pretest and posttest of the control and experimental groups, it was concluded that improving the representation ability of hearing impairment students was included in the very good category. The provision of assistive learning technology in the experimental class has a good impact on the representation ability of hearing impairment students.

Assistive learning technology used in this study is a gesture learning video developed in collaboration with a plugin from H5P. So, sometimes a question arises related to the topic of fractions. The questions provided allow hearing impairment students to express their

thoughts (Ismaili & Ibrahim, 2017). The media provided is not one-way, only includes material. But it also provides opportunities for students to communicate (Tony, 2019).

The features provided on the assistive learning technology media are multiple choice questions, descriptions, short answers, or responses to the topic. However, the answers from the hearing impairment students could be.

The advantage of H5P-based interactive sign language videos is that they are flexible, which means they can be accessed anywhere and anytime. Students can understand the material through H5P-based interactive sign-language videos independently without a teacher and can improve the mathematical understanding abilities of deaf students. In addition, in this study, students did not get bored quickly just watching videos. Students could do the practice questions enthusiastically with very varied interactive H5P. The disadvantages of H5P-based interactive sign language videos is that they require a stable internet network. According to Pinoa and Hendry (2021), using the H5P feature requires a stable network.

## CONCLUSION

The provision of assistive learning positively impacts on the representation ability of hearing impairment students. Assistive learning technology is more effective than the group not given the media. In addition, hearing impairment students' learning independence and enthusiasm are more formed. There is a need for research and development of more interactive sign language learning media for deaf students

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