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# DEVELOPMENT OF FLASHCARD MEDIA BASED ON AUGMENTED REALITY TO IMPROVE THE SPEAKING ABILITY OF AUTISTIC STUDENTS AT SLB AUTIS LABORATIUM UM

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**Abstract.** Autistic students experience developmental disorders that affect various aspects, namely thinking ability, socialization, communication, and behavior in accepting abstract things. Based on preliminary studies at SLB Autis Laboratorium UM, they experience limited new vocabulary that affects their speaking ability so that echolalia characteristics often appear in the learning process. In addition, the learning media used are still limited and less innovative in teaching abstract things to students. The purpose of this research is to develop learning media in the form of augmented reality-based flashcards that are effective and valid and can improve speaking skills, especially in pronouncing vocabulary and questioning activities or having simple conversations, especially for autistic students where 3D animated animal models will appear followed by audio explanations when used. This study uses a research and development method developed by ADDIE with 5 stages of development, namely (1) Analysis; (2) Design; (3) Development; (4) Implementation; (5) Evaluation. The subjects in this research and development are media experts, material experts, practitioners, and 3 autistic students from class III. The data collection techniques used were observation, interviews, questionnaires, and documentation. The results of this study indicate that Augmented Reality-Based Flashcard media are feasible and effective in using Indonesian language learning at the UM Laboratory Autistic SLB. This is evidenced by the media validation test score of 98% and 100%, the material validation test score of 100% and 100%, and the assessment of the results of the practitioner validation test of 82% and 98%. The overall assessment of the validation test that has been carried out is 96% (Very Valid). In addition, the overall assessment of the small group trial that has been carried out is obtained at 87.5% (Highly Effective).

## INTRODUCTION

Autism is a developmental disorder that has a major impact on an individual's ability to communicate both verbally and nonverbally, as well as in social interaction, which also affects their ability to achieve success in the learning process. World Health Organization's International Classification of Diseases (ICD-10) describes autism, especially childhood autism, as the presence of abnormalities and or developmental disorders that appear before reaching the age of three with abnormal characteristics in three main areas, namely social interaction, communication, and repetitive behavior patterns (Sunarsih, 2021). One of the

hallmarks in the development of children with autism is difficulty in communicating and difficulty in receiving messages (Widana et al., 2023). Some of the communication and language barriers experienced by autistic children include delays in speech such as the tendency of echolalia or imitating other people's conversations but difficulty in understanding the meaning of the words that have been spoken and difficulty in two-way communication (Adi, 2022). Children with autism often have difficulty in showing interest in social interactions, which can be observed from a lack of eye contact, limited facial expressions, unpredictable and situational inappropriate behaviour, as well as frequent emotional fluctuations, such as sudden anger or crying. This results in difficulties for children with autism to interact with others, and they are often alienated by their peers (Iskandar, 2020).

Difficulties in communication, especially speech, in children with autism are caused by partial brain dysfunction. Speaking refers to the act of using verbal language with the intention of conveying and expressing thoughts or emotions through words or sentences (Astuti & Mulyanto, 2023; Sumandya et al., 2023). This is in line with Tarigan in (Madeamin, et al., 2023) that speaking ability is one of the aspects of language skills that are interconnected with listening, reading, and writing skills or referred to as "Single Chess". These behavioral disorders include reduced social interaction, avoidance of eye contact, difficulties in language development, repetitive actions, and lack of cognitive abilities in children with autism. This is reinforced by (Neviyarni, 2020) that language development and cognitive development occur simultaneously and independently. Cognitive development in children with autism is different from children in general, characterized by indifference to auditory stimuli and difficulty in understanding more complicated instructions. With good speaking skills, students have the opportunity to get information about various aspects, including what, who, where, when, why, and how, both in the context of school and in society, from various situations they experience (Harianto, 2020).

A person with a verbal communication disorder will show characteristics such as difficulty speaking, possible loss of speech, use of language that is not understood by ordinary people, and frequent repetition of words. Speech impairment in children with autism is often characterized by signs such as lack of facial expressions, lack of use of body language or gestures, infrequent initiation of communication, non-imitation of gestures or sounds, limited or absent speech, repetition of words or monotonous speech, and unusual vocal intonation or rhythm, lack of understanding of the meaning of words, and restrictions in the use of words (Lestari., 2013). This limitation in vocabulary results in many of the words they say being difficult to understand. Those who can speak also tend to imitate speech and perform echolalia.

Based on the results of a preliminary study conducted at SLB Autis Laboratorium UM, the teacher has not found and made media that is attractive to students and adapted to the learning style of children with autism, namely audio-visual, especially for material that is classified as abstract, for example in animal recognition. The research subject shows a disturbance in the aspect of language and communication, reflected in the child's speech which is not optimal and has an impact on student verbal communication. Moreover, learning for students with autism must start from concrete, semi-concrete, and abstract things. So that teachers must find ways to teach students according to their learning stage, namely making an abstract thing into a concrete thing. This is in line with (ERochyadi, n.d.) revealed that teachers must consider several things when delivering learning media including:

(1) materials are not harmful, easy to obtain, can be used by children; (2) colors are not flashy and not abstract; (3) the size must be used or regulated by the child himself (the size of the table and chair).

Learning media in the form of augmented reality-based flashcards is a type of audio-visual media that allows teachers to real-time display objects or other elements on the screen with more realistic images, creating a more authentic experience for children. The function of flashcard learning media is to train the right brain to remember images and words, so that children's vocabulary and language skills can be trained and improved (Oktaviana R., & Nabila Fadia, N., 2023). Through the use of Flashcard Augmented Reality, students have the opportunity to interact with 2D objects contained in Flashcards and 3D objects presented through Augmented Reality technology. This will make it easier for students to more freely observe the object from various points of view. In accordance with research (Anggreani & Satrio, 2021) that the use of augmented reality flashcards aims to make the learning display more attractive and look real so that it makes it easier for children to understand concepts. In addition, this media can stimulate learning for students with autism by paying attention to the concrete, semi-concrete, and abstract learning stages in understanding animal concepts (Makapedua, et al., 2021; Widana et al., 2023).

According to the description and problems above, it is necessary to develop language learning media, especially in material that is fairly abstract so that students understand more quickly, are happy, effective and improve learning outcomes. Improving the quality of learning can be achieved by providing more varied learning media, according to the needs of students with autism who tend to be less focused, hyperactive, and easily bored. This approach is expected to help students understand and remember learning materials (Munfarikhatin, 2021). The title of this research is "Development of Augmented Reality-Based Flashcard Media to Improve the Speaking Ability of Autistic Students at SLB Autism Laboratory UM".

## METHOD

In this study, the method used is a research and development method also known as Research & Development (R&D). This research and development adopts the ADDIE model which is composed of five sequential stages and related to each other, so that in its application, the stages in the ADDIE model cannot be changed and must be followed sequentially (Dick and Carey, 2001). The stages in the ADDIE research model consist of Analyze, Design, Development, Implementation, and Evaluation. The ADDIE research model is one of the research models that has been designed with programmatically structured activity steps with the aim of solving learning problems that are in accordance with the needs and characteristics of students, as well as related to learning resources. This is in line with the opinion (Madiya, I. W., 2020) that this model can be used for various models, learning strategies, media and teaching materials. This is the reason for choosing the ADDIE model because the basic stages of its development design are considered a simple process, easy to learn, simple, and easier to apply in the development of learning media that can be accounted for through a research and development approach.

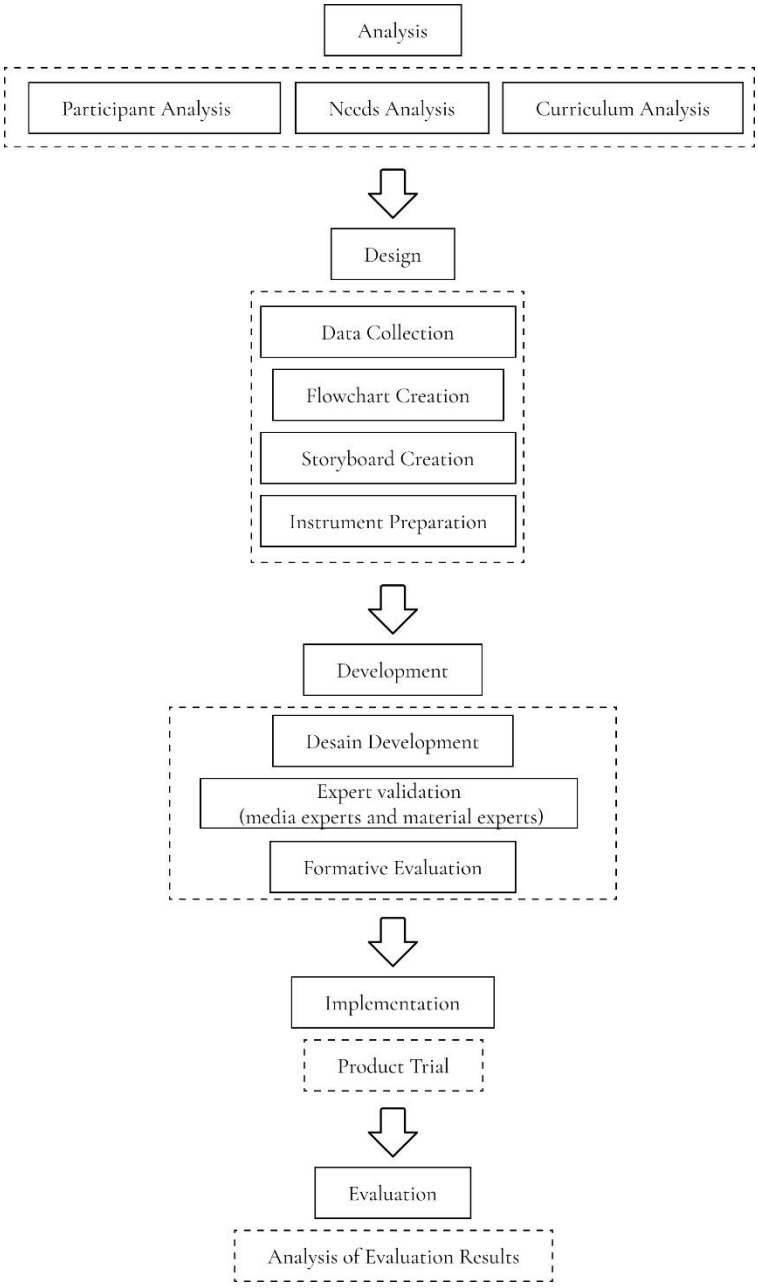


**Image 1.** ADDIE Research Model

The type of data presented in research and development consists of quantitative data and qualitative data with data collection methods in this research and development in the form of observation, interviews, questionnaires, and documentation. Observations and interviews were conducted to determine curriculum analysis, learner analysis, and needs analysis to overcome previously identified problems. While questionnaires or questionnaires are conducted to collect information related to the validity and effectiveness of Flashcard Augmented Reality media that has been developed (Sumbung, E., 2020). For data analysis techniques utilizing two approaches, namely quantitative data analysis to determine the level of validity of the media based on questionnaires or questionnaires from the results of

validation tests conducted by expert validators, namely lecturers in the form of percentages and small group trial data conducted by research subjects, namely autistic students in class III to determine student responses to the level of usefulness of augmented reality flashcards as an effective learning media to improve student speaking skills and qualitative data analysis to analyze the results of observations and interviews using descriptive analysis techniques.

Questionnaires to validate augmented reality flashcard media filled by 2 material expert lecturers, 2 media expert lecturers, and 2 expert practitioners using Likert scale measurements with a scale of 1-5 for the answers to each instrument. The rating scale of the Likert scale (Dasril, K., 2021) is as follows:

**Table 1.** Indicators of Expert Validation Assessment

| Score | Description |
|---|---|
| 5 | Very Good |
| 4 | Good |
| 3 | Good Enough |
| 2 | Not Good |
| 1 | Sangat Tidak Baik |

Next, after obtaining the assessment results from the Likert scale, the data will be inputted into the formula to calculate the validity score of the augmented reality flashcard media. The formula used in the calculation (Arikunto, 2013) is as follows:

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

Description:
S = Score
$\sum x$ = Number of scores obtained
$\sum xi$ = Total number of scores

After getting validation scores from three experts, the average validation score was analyzed again to find the average score as a percentage of the three experts. Analysis of the average validation score Arikunto (2013):

$$X=\frac{\sum x}{N} \quad \text{..... (2)}$$

Description:
$X$ = Mean (average)
$\sum x$ = Total of all values
N = Number of validators

After knowing the results of each validity test, the next step is to calculate the validation to reach a conclusion (Arikunto, 2013) using the formula:

$$V = \frac{\text{Vmedia+Vmaterial+Vpractition}}{\text{N expert}} \text{ x } 100\% \quad \text{..... (3)}$$

Then, the average percentage data is entered into quantitative data and can be grouped based on the interpretation of scores according to the Likert scale as the basis for making product

evaluation decisions. So that a conclusion will be obtained about the validation and feasibility of Flashcard Augmented Reality learning media developed. The following criteria are criteria for evaluating the percentage data of product validation, specifically using qualification adaptation (Arikunto, 2013).

**Table 2.** Product Validation Assessment Qualification Criteria

| Criteria | Validity Level | Description |
|---|---|---|
| 76% - 100% | Very Valid | Suitable for use without revision |
| 51% - 75% | Valid | Usable with minor revisions |
| 26% - 50% | Fairy Valid | Usable with major revisions |
| 0% - 25% | Less Valid | Not yet fit for use |

Meanwhile, the data on the results of small group trials that have been conducted on research subjects, namely class III autism students where the measurements use the formula as follows:

$$S=\frac{\sum x}{\sum xi} \text{ X } 100\% \quad \text{..... (4)}$$

Description:
S = Score
$\sum x$ = Number of scores obtained
$\sum xi$ = Total number of scores

After getting the calculation score of each subject, the next step is to enter the score results with the formula listed in Figure 3 to find out the overall calculation score that has been done by all research subjects.

The effectiveness of the development of Flashcard Augmented Reality learning media is determined based on the completeness of the Minimum Completeness Criteria (KKM) for autism students at SLB Autism Laboratium UM Malang, which is 70. The percentage of subject completeness in the trial was calculated using the following formula (Anshori, S., 2017):

$$P=\frac{\sum \text{students who score} \geq 70}{\sum \text{students take the test}} \text{ X } 100\% \quad \text{..... (5)}$$

Furthermore, the data obtained will be entered into Table 3 to determine the effectiveness criteria of the Augmented Reality Flashcard media.

**Table 3.** Media Effectiveness Test Qualification Criteria

| No | Mastery | Qualification | Category |
|---|---|---|---|
| 1 | 81% - 100% | Very High | Very Effective |
| 2 | 61% - 80% | High | Effective |
| 3 | 41% - 60% | Less High | Less effective |
| 4 | 21% - 40% | Low | Ineffective |
| 5 | < 20% | Very Low | Very Ineffective |

## RESULTS AND DISCUSSION

Augmented Reality Based Flashcard media development is structured using the ADDIE research model. These are the stages of the ADDIE model as follows:

### 1. Analysis

The analysis stage is carried out to find out the problems experienced by students and analyze the needs by conducting observations and interviews at SLB Autis Laboratium UM. At this stage, researchers conduct learner analysis, curriculum analysis, and needs analysis as guidelines in developing media. After analyzing, the data obtained shows that schools are still limited and less innovative in offering learning media as a tool in learning activities, especially in material that is fairly abstract for autistic children. So that students contribute less and look bored in learning activities, especially in Indonesian subjects in question and answer activities. Based on the above problems, it is necessary to develop learning media, especially in teaching abstract things to attract students' attention. Therefore, researchers developed Augmented Reality Based Flashcard media to develop students' speaking skills.

### 2. Design

The steps in the design stage start from analyzing the data that has been done at the analysis stage to determine the learning objectives to facilitate the process of preparing the material in the media. In addition, researchers designed the concept of augmented reality flashcards to be developed starting from sketching media designs in the form of 2D displays or 3D displays in the form of flowcharts and storyboards. Followed by designing the physical design of augmented reality flashcard media. Researchers determine the principal prayer material in Augmented Reality Based Flashcard media, namely the introduction of animals based on the number of legs.

### 3. Development

The development phase is a follow-up step from the planning stage. In this phase, researchers implement the design that has been made into prototype 1 or physical form, namely the product. The product that will be designed by researchers is Augmented Reality Based Flashcard media. Furthermore, validation tests will be carried out on the media or products by validators, namely media experts, material experts, and practitioners to determine the feasibility of the product, including the validity of the material and the effectiveness of Augmented Reality-Based Flashcard learning media. The stages carried out are:

a. Determine the design that has been made as a display of prototype 1 or media products developed. The product display contains a cover, guide or steps for using the media, material content in the form of images of 2-legged and 4-legged animals, and the benefits of using the media.

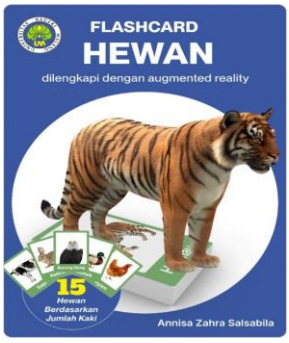


**Image 2.** Cover View


**Image 3.** Display of Media Usage Steps

The learning media user card is designed to provide clear and easy-to-follow instructions for users so that they can use the learning media effectively. The card has a practical size, large enough to display information clearly but small enough to be easily carried or stored.


**Image 4.** Display of Material Content

On this card contains the core material of the existing learning media title, namely the introduction of animals based on the number of legs. When the animal image on this card is scanned via a mobile phone, an augmented reality image will appear on it accompanied by the sound of the animal as an explainer.


**Image 5.** Media Benefits Display

This card contains the benefits of using augmented reality-based flashcards

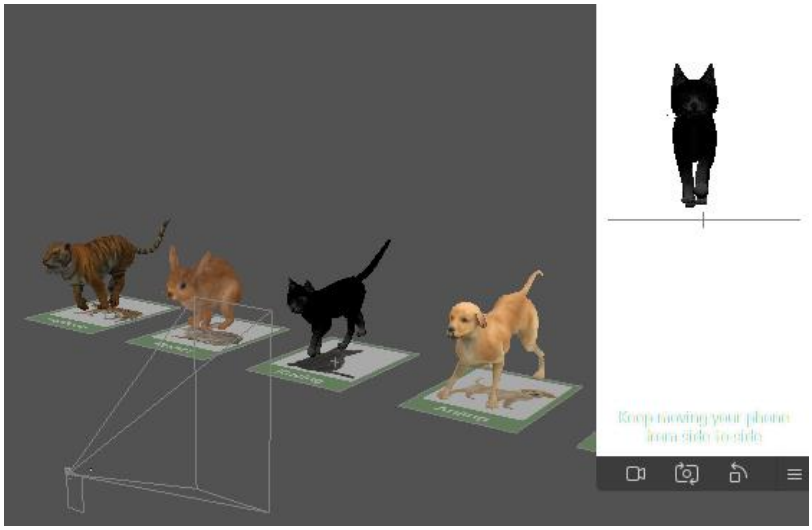

**Image 6.** 3D Augmented Reality Display

b. After prototype 1 is revised, testing is carried out on the developed media to ensure that the device functions as desired or expected or the marker image tracking feature runs well.
c. Publish or upload the design part of the augmented reality display as an Instagram filter where this feature aims to activate augmented reality on flashcards when scanned through a smartphone camera.
d. Conduct validation tests by validators, namely media experts, material experts, and expert practitioners to determine the feasibility and validity of the developed media.

**Table 4.** Data on Media Validation Results of Augmented Reality Flashcards

| No. | Media Quality Assesment Learning | Percentage | Description |
|---|---|---|---|
| 1 | Material expert | 100% | Very Valid |
| 2 | Media expert | 98% | Very Valid |
| 3 | Practitioner expert | 90% | Very Valid |
| Average assessment result | | 96% | Very Valid (Feasible to use without revision) |

Based on the validation score above, the overall augmented reality flashcards scored 96% so that it is included in the "very valid" category and feasible to be tested in the field.

## 4. Implementation

At this stage, researchers conducted small group trials with 3 research subjects, namely grade III autistic students. The purpose of this small group trial was to assess the effectiveness of the augmented reality flashcard media that had been developed. Evaluation of effectiveness is done by comparing student test results with the KKM value set by the school. Data regarding the speaking ability of autism students will be presented in tabular form, so as to obtain information about the user test scores obtained from UM Laboratory Autistic SLB students.

**Table 5.** Small Group Trial Results

| No | Student scores related to learning media | Pre Action | Post Action |
|---|---|---|---|
| 1. | AL | 70.3% | 96.2% |
| 2. | NL | 59.2% | 92.5% |
| 3. | YS | 51.2% | 74.0% |

Based on Table 5, the overall data from the small group trial results have been presented to determine the effectiveness of augmented reality-based flashcard media. The final results obtained reached the qualification criteria "Very Effective" with a score of 87.5% obtained from the average score of the three research subjects.

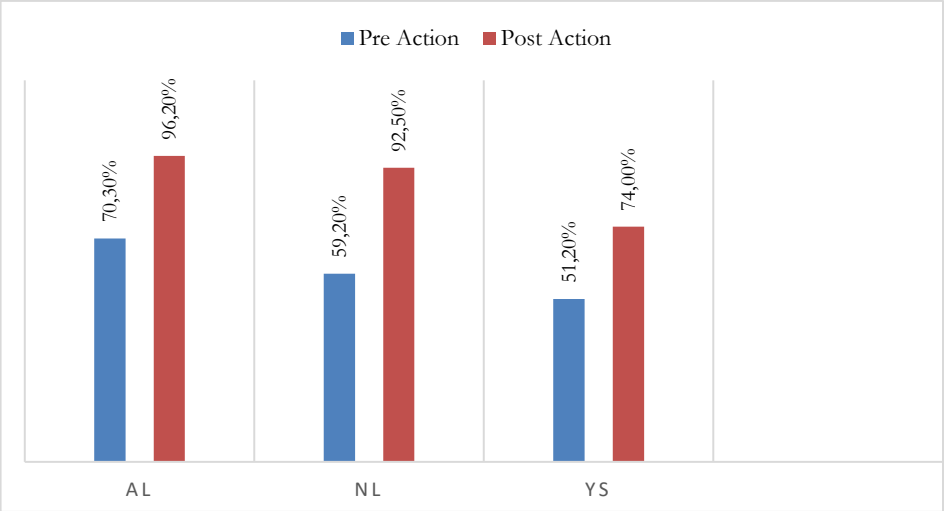


**Image 7.** Graph of Evaluation of Overall Student Learning Outcomes

This is in line with the opinion that learning media is any form that can be utilized as a tool to convey messages with the aim of stimulating students' thoughts, emotions, attention, and abilities in the learning process.

## 5. Evaluation

In this study, the evaluation stage used in this development research is formative evaluation and summative evaluation. Formative evaluation aims to improve the product and is carried out at each stage, starting from analysis, design, development, to implementation. On the other hand, summative evaluation is carried out at the final stage of development, namely the stage of application or media trials in the field, with the aim of evaluating media quality based on qualification criteria and students' interest in learning activities on learning media. Augmented reality-based flashcard media is a product developed based on a needs analysis conducted at the UM Laboratory Autistic SLB as a learning tool for teachers in improving students' speaking skills and teaching concepts or abstract things that make it easier and attract the attention of autistic students.

The developed flashcards are 8.5 x 6 cm in size with 310 gsm art paper coated with glossy laminating and oval cut card edges. These flashcards certainly have 2D and 3D visual displays that can attract students' attention. In addition, augmented reality flashcards media equipped with audio related to animal recognition material will also be added, for example the sound of a cat accompanied by an explanation of the cat animal that supports the learning process. The role of sound or audio is not only to provide an auditory dimension, but also to enrich students' learning experience, making the material more vivid. This is in line with (Anshori, S., 2017) that learning media packaged in audio, video, animation and computers, both accessible online and offline, are learning tools that can be used flexibly according to the circumstances and situations of both teachers and students, anywhere and anytime. With the presence of these flashcards, it is expected that students can get used to and be able to pronounce the vocabulary contained on the cards. Thus, the media in the form of augmented reality flashcards is expected to help teachers improve the effectiveness of vocabulary learning, make it more interesting, and create a fun learning experience for students.

Based on the explanation above, it can be concluded that the Augmented Reality Flashcard media has undergone an overall evaluation and received a very feasible and valid assessment and is very interesting in its application.

## CONCLUSION

Based on the results of the research that has been carried out, the following data is obtained: The product produced in the form of Flashcard Augmented Reality media. (1) the flashcard augmented reality media is very valid and feasible to use without the need for revision. (2) All students successfully completed the Indonesian language learning activities in question and answer activities on simple topics as evidenced by the scores of the three students exceeding the school's Minimum Completion Criteria (KKM), which is 70.0. AL students achieved a score of 96.2, NL achieved a score of 92.5, and YS students scored 74.0. Therefore, flashcard augmented reality media proved to be very effective in supporting Indonesian language learning, especially in question and answer activities to improve students' speaking skills.

In order for flashcard augmented reality media in improving speaking skills to be useful in learning activities, there are several suggestions, among others: (a) teachers are recommended to use this flashcard augmented reality media to improve the speaking ability of autistic students; (b) learners are advised to be more active in learning, because flashcard augmented reality media is easy to use and attracts students' attention in the hope that the level of understanding and speaking ability of students will continue to increase; (c) to other developers who will continue so that this product can not only be applied at SLB Autis Laboratium UM, but can also be applied in all schools, especially in schools that do not yet have a variety of learning media. In addition, future researchers are also expected to increase creativity in making media that are more varied, more interesting, and conduct extensive trials to assess the effectiveness and feasibility of the media.

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