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# Development of Tactile Audio Media for Low Vision Students

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**Abstract**: This study aims to develop a valid and effective audio tactile learning media to improve the learning achievement of students with visual impairments, especially low vision. The development model used is the 4D model (Define, Design, Develop, and Disseminate). Data collection techniques include observation, interviews, documentation, and tests. This study uses a quantitative approach as a data analysis technique. The product developed is a set of learning media consisting of audio media and tactile media for mathematics statistics courses. Audio media in the form of power point video containing sound and supported by several tactile media such as colored dice, coins, colored coins, number cards, bridge cards and colored cubes. The results of expert validation tests carried out on the developed instruments are categorized as valid and effective.

**Keywords**: Audio Media; Tactile Media; Low Vision; Mathematical Statistics

## INTRODUCTION

The law on the national education system states that every citizen has the same right to obtain quality education. The regulation also specifies that citizens who experience physical, emotional, mental, intellectual and mental disorders. They have the right to special education, with the result that education is not only for normal children but also for children with special needs. Children with special needs are defined as children who experience physical, mental-intellectual, social, or emotional limitations or limitations that are very influential in the process of growth and development compared to other children of their age.

Blind is one type of disability who has limited vision. Blind people are divided into two types, namely low vision and blind. This grouping is used as a basis for handling the learning process. Low vision is a visual impairment that still has residual vision and can identify visual information with tools. Those who still have residual vision but are unable to use their eyesight to read 12-point ordinary writing in normal light conditions even though they are assisted by glasses (Pertuni, 2004). While the blind are people who cannot access visual information at all (Roe & Wester, 2003). Psychologically, blind people have excessive worries because of their limited ability to control environmental conditions. This makes blind people often experience excessive fear. The impact is lack of confidence, not independent, angry, aloof, passive, easily discouraged, and difficult to adjust (Hadi, 2005).

Based on data from the Central Statistics Agency, the number of blind people in Indonesia reaches around 3.5 million people or about 1.5 percent of the total population (Fitriyah, 2013). With this large enough number, the Government should pay attention to the educational needs of them. Education for the blind must be maximized to become productive people. Schools do not only develop cognitive potential but also provide intercommunication. Integrated education can develop the communication skills of blind students. With the result that, they can get along well with their surroundings (Bowen, 2010).

One of the provisions given at school is mathematics. Mathematics provides students with logic, confidence in solving problems, and drawing conclusions to solve everyday problems (Aisyah & Retnawati, 2014). The problem that is often faced in learning mathematics is that students are not accustomed to practicing problem solving skills on math problems (Dwina &

Suherman, 2014). This situation causes the low problem solving ability of students (Mawaddah & Anisa, 2015).

Mathematics material for college level is more difficult to learn because the material presented is more abstract, such as in the Mathematics Statistics course. This course is one of the courses at the undergraduate level of the Mathematics Education Study Program. The material studied is more theoretical in nature such as the concept of probability and distribution of random variable functions (Gantini, T & Herrhyanto, N: 2009).

In learning for children with special needs, learning resources play an important role (Retnawati, Prajitno & Hermanto, 2015). Limited learning resources and teaching aids are a problem in the learning process for students with low vision. Those who experience visual impairments need real context and hands-on practice in learning mathematics (Arlinwibowo & Retnawati, 2015). Students or students with visual impairments usually learn mathematics by memorizing mathematical formulas. Thus, the learning process becomes meaningless. As a result, they are less motivated in learning (Arlinwibowo & Retnawati, 2015). The results of previous studies showed that low vision students did not have the motivation to attend lectures. These students tend to be lazy, lack initiative and lack confidence in attending lectures in the Mathematics Education study program. This attitude shows that there is a problem with low vision students' motivation in learning mathematics.

Motivation is one of the important things that affect the learning process. Motivation is an impulse that leads to the goal to be achieved (Arlinwibowo & Retnawati, 2015). Indications of motivation are willingness to learn, effective time management, diligent, persistent, happy and curious. Therefore, motivation will have an influence on each learning outcome (Gottfried & Hudley, 2008). Students' motivation to learn comes from their subjective experiences, especially those related to their willingness to be involved in learning activities and their reasons for doing so (Brophy, 2010). In a task, especially a relatively difficult one, students must be able to maintain their motivation to achieve good results (Sullo, 2009). Teachers can see the motivation of students' attitudes when receiving relatively difficult questions (DeCaro, DeCaro & Rittle-Johnson, 2015). Therefore, learning motivation is an important aspect that influences achievement of learning.

Learning for low vision students is to minimize visual information. Thus, people with low vision can maximize the work of both the senses of touch and the senses of hearing (Hersh & Johnson, 2008). Visual images can be packaged into concrete objects or media that can be touched or information in the form of audio.

According to Whittingham (2013), audiobooks can be accessed well by blind students. Even the presence of audiobooks can increase the spirit of reading. Audiobooks are the result of visual information technology that can be converted into non-visual information (Mani, at. al., 2005). Which can have an influence on the motivation and achievement of the visually impaired. One of the advantages of audiobooks is that they can facilitate students to study independently, whenever and wherever involving hearing and touch can provide flexibility for people with low vision to learn mathematics contextually. Concrete learning will make it easier for students to understand it (Retnawati, Prajitno & Hermanto, 2015). The material taught contextually can give meaning to the material. The meaning of what is learned will be stored in long-term memory (Kyriacou, 2010). One strategy for learning mathematics is to include information in long-term memory. New ideas and experiences are transferred from short-term memory to long-term memory which are stored and used at a later date. The process will be supported by strong motivation and emotions (Kennedy, Tipps, & Johnson, 2008).

Therefore, in this study, tactile audio media was developed so that it could be accessed by students with low vision. All visual information that is commonly used for the learning process will be converted into audio-based and touch-based. The hope is that there will be an

increase in motivation and learning achievement of low vision students. Thus, the purpose of this study is to develop audio tactile media for mathematical statistics courses that meet the valid and effective requirements.

## METHOD

Research is a research development that uses the 4D model (Define, Design, Develop, Disseminate), will be but at this research stage disseminate not done. The purpose of this research is to produce audio tactile media for low vision students in mathematical statistics courses that are theoretically and empirically feasible. The material for mathematical statistics that will be developed includes; (1) experiments, sample spaces and events in statistics, (2) sample points and (3) probability.

The theoretical feasibility data collection technique uses the method of review and validation. The results of the review are in the form of suggestions and input related to the initial draft to produce a second draft. At the review stage, the second draft was validated using a validation sheet instrument carried out by three validators, namely media expert lecturers, material expert lecturers, and Tuban blind special school teachers. The validation sheet is prepared based on the National Education Standards Agency. The questions are adjusted to the needs of the researcher. The validation sheet covers four aspects, namely: (1) presentation feasibility component, (2) content feasibility component, (3) linguistic feasibility component, and (4) differentiated learning suitability. The assessment uses the criteria of "yes" and "no" with a score of 1-4 based on a Likert scale according to Riduwan (2013). The validation results are then analysed quantitatively descriptively with the percentage for eligibility criteria (Riduwan, 2013). The criteria is not feasible (25-40%), less worthy (41-55%), decent enough (56-70%), worthy (71-85%), and very worthy (86-100%). Media audio tactile said theoretically feasible when obtaining a score of > 70%.

As for the student test data, the data analysis technique used in this study is nonparametric statistics and uses the Wilcoxon Match Pairs Test formula as follows:

$$Z = \frac{T-\mu_T}{\sigma_T}$$

Z: The value of the Wilcoxon match pairs test statistic test
T: The smallest number of levels/ranks
$\mu_T$: Mean (average value) = $\frac{n(n+1)}{4}$
$\sigma_T$: Standard deviation = $\frac{\sqrt{n(n+1)(2n+1)}}{24}$
n: Number of samples

## RESULT AND DISCUSSION

### Result(s)

In the define stage, search and data collection is carried out regarding the characteristics of appropriate media for low vision students in inclusive education settings. To obtain data regarding the characteristics of this media, interviews were conducted with research subjects consisting of two students with low vision, Faculty of Teacher Training and Education, PGRI Ronggolawe University, Tuban and a teacher who teaches blind students at the Tuban State Special School. Based on interviews conducted on research subjects, information on media characteristics that are suitable for low vision students includes (1) involving auditory, (2) involving information technology, (3) describing pictures or mathematical symbols, (4) involving touch or palpation. , (5) font size is more than 18, (6) use a magnifier to read books or read power point, (7) require lighting and colour combinations.

Furthermore, based on the information and data that has been obtained at the define stage, the design stage is continued. At the design stage, appropriate media are planned for low vision students. In this planning process, the researcher chose the type of application that was suitable for the characteristics of low vision students. It is also an application that is easy to use for users and is compatible with various devices. Based on these considerations, audio and tactile media were chosen for low vision student learning. In addition to the media, reading aids in the form of a magnifier are also provided. Audio media in the form of Microsoft Power Point with sound, while tactile media in the form of colored dice, coins, colored coins, number cards, bridge cards and colored cubes. Power point is one of the Microsoft Office programs used for presentation purposes. This presentation is presented in the form of slides supported by various media such as images, animations, videos and includes audio media (Fauziah & Pradipta, 2018). Audio media can be inserted into the power point so that users understand the power point better through additional audio assistance. For low vision students, this audio media is the main source of information in accessing the material in the power point being studied. Power point also makes it easier for teachers to deliver subject matter so that it can support an effective and efficient learning process (Rahayu, 2012). While tactile media is an artificial media that functions the sense of touch or touch. Tactile or imitation media in the learning process will make it easier for students to re-learn the material presented through media that have been created with various innovations and creativity that arise. Thus, creative behavior can be realized, both cognitive and affective characteristics (attitudes and values) of creativity need to be developed in an integrated manner in the learning process (Caliphate, 2018). In this study, the tactile media developed were large colored dice, colored coins, number cards, bridge cards and colored cubes. Tactile media is used together with audio media by low vision students when learning mathematics statistics. They not only learn by using the sense of hearing, but also the functioning of the senses of touch and touch. So that by optimizing more than one sense in learning, it can help them to process information more easily. Examples of results from audio media and tactile media developed can be seen in the figure 1.

**Figure 1. Tactile Media for learning opportunities, permutations and combinations**

***Validation Data Analysis Results***

In the validation of lesson plans by learning design experts, the average value of the percentage is 82%, the percentage is in the proper category. So, it can be said that the lesson

plans used are feasible to be developed using tactile audio media. In material validation by material experts, the average percentage value is 89%, the percentage is in the very feasible category. On media validation by media experts, the average percentage value is 88%, this percentage is in the very feasible category. So it can be said that the developed media is very feasible to use.

***Test Data Analysis Results***

Analysis of test data was used to determine the effectiveness of using tactile audio media in mathematics statistics courses for low vision students at the Faculty of Teacher Training and Education, PGRI Ronggolawe University.

**Table 1 List of Pre Test and Post Test Results**

| Name | Pre test | Post test | Name | Pre test | Post test | Name | Pre test | Post test |
|---|---|---|---|---|---|---|---|---|
| S1 | 51 | 85 | S7 | 59 | 90 | S13 | 52 | 87 |
| S2 | 45 | 81 | S8 | 70 | 95 | S14 | 56 | 88 |
| S3 | 50 | 90 | S9 | 70 | 98 | S15 | 54 | 82 |
| S4 | 60 | 95 | S10 | 50 | 87 | S16 | 50 | 82 |
| S5 | 40 | 87 | S11 | 55 | 90 | S17 | 60 | 90 |
| S6 | 42 | 85 | S12 | 53 | 85 | S18 | 60 | 85 |

Average: pre-test: 54.28 and post-test: 93.33

Low vision student subjects were given the initials S5 and S6. Based on Table 1, the learning outcomes of low vision students have increased. Based on classical learning outcomes, inclusive class learning outcomes in mathematics statistics courses, especially statistical events and opportunities have increased. This can be seen from the average pre-test 54.28 increased to 93.33 in the post-test results. The increase in the ability of low vision students can be seen in the figure 2.

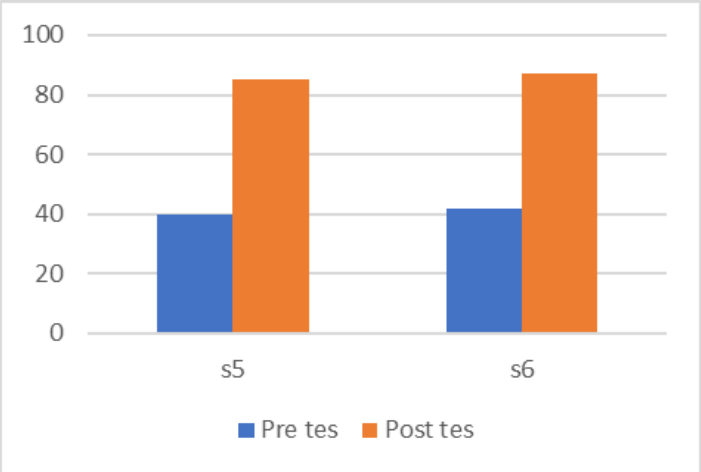


**Figure 2 Results of the Recapitulation of Pre Test and Post Test of Low Vision Student Achievement**

The graph in Figure 5 shows an increase in the mathematics statistical learning outcomes of low vision students. The purpose of this study is to test whether or not there is a difference between the variables X and Y, so 5% = 1.96 where n = the number of samples as many as 18 students. H0 is accepted if Z count > Z table 1.96 and H0 is accepted if Z count 2.20 < Z table 1.96. According to Sugiyono (2012:163) the two-party test is used when the null hypothesis (H0) reads "equal to" and the alternative hypothesis (Ha) reads "not equal to" (H0=; Ha≠). In this study, two-sided testing is used which is intended to test two sides, namely Z count

(calculated Z value) and Z table (Z table value). The processed sign test resulted in a positive sign in all subjects.

Based on the results of the study before using tactile audio media, it obtained an average of 54.28, then after using tactile audio media it obtained an average of 93.33. In addition, the results also show that Z count = 2.20 is greater than Z table = 1.96 with a crisis value of 5% with n = 6, Z count = 2.20 > Z table = 1.96. Based on these results, it is proven that the use of tactile audio media is effective in improving mathematics statistics learning outcomes.

**Discussion(s)**

Media audio is a media that is appropriate to use the blind for media audio use traditional modalities of hearing in giving information that wants to be delivered. Audio media can provide a verbal learning experience so that it can increase students' understanding of the material being studied (Delani, 2017). The results of this study indicate that audio media can improve mathematics statistical learning achievement in students with low vision. Audio media not only helps low vision students to understand mathematical concepts but also to understand other concepts. M edia audio in the form of a power point with a voice to improve the achievement of students with visual impairment in learning Courses Audio Verbal Therapy (AVT) (Rafikayati & Muhyi, 2020).

Due to the visual impairment that occurs in low vision, lecturers must think innovatively to develop learning media that are in accordance with the characteristics of low vision to help them learn, especially in today's online learning. Audio media as a medium that can accommodate hearing modalities as the main learning tool for the blind can be a solution to the problem. Audio media is media related to hearing, information is conveyed through verbal auditory symbols (Sadiman, 2010). Audio media can stimulate the mind and help in gaining knowledge, especially for users who have an auditive learning method and the visually impaired are included in this learning style. Furthermore, interactive audio learning is a medium for the blind to interact with learning (Dariyati et al., 2015).

In addition to using audio media, to help a blind person or person with low vision in learning can also maximize other senses. Loss of visual perception, blind students develop other abilities, such as hearing improvement. During the sensorimotor period (birth to 2 years) blind children need to experience a lot of auditory and tactile stimuli so that auditory and tactual perceptions can develop together to facilitate movement: rolling, dragging, balancing, supporting, and walking. Auditory sensory information must be integrated with other sensory to build intelligence, imagination about objects, spatial organization, etc. (Boas, et.al. 2011). Media that involves touch or touch (tactile media) can be used together with audio media. Learning media in the form of tactile media can help students understand geometry material so that the mathematical imagination ability of blind students on the material properties of rectangular shapes and the combined area of rectangular shapes fulfills all indicators of mathematical imagination ability (Romdhiana, 2020).

## CONCLUSSION

The development of tactile audio media for low vision students consists of three stages, namely, the define stage, the design stage and the develop stage . The products resulting from this research are audio media and tactile media. Audio media in the form of power points with sound, while tactile media in the form of large colored dice, colored coins, coin currency, number cards, colored blocks. Audio media and tactile media are used together to assist low vision students in attending mathematical statistics lectures on statistical events, probabilities, combinations and permutations. The developed tactile audio media meets the valid and effective requirements. By using this media, the achievement of learning mathematics statistics for students with low vision has increased.

This tactile audio media for low vision students is expected to increase the understanding of low vision students towards the material being studied, especially in the Mathematics Statistics Course. The results of this development can be a model for the development of learning media for people with low vision or visual impairment in universities. In addition to the development that has been carried out, it is necessary to carry out further developments in other subjects so that students with visual impairments can learn optimally.

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## REFERENCE

Aisyah, U. & Retnawati, H. (2014). Development of learning tools for high school mathematics difficult competencies in Riau. *Journal of Mathematics Education Research*, Vol. 1(1), 2014, 98-112

Arlinwibowo, J., & Retnawati, H. (2015). Developing audio tactile for visually impaired students. *International Journal on New Trends in Education and Their Implications*, 6 (4), 78-90.

Bowen, J. (2010). Visual impairment and self-esteem. The British Journal of Visual Impairment. Vol. 28(3), 2010, 235-243.

Brophy, J. (2010). Motivating student to learn (3rd Ed.). New York: Routledge

Dariyati, I. G. A., Marhaeni, A. A. I. ., & Widiartini, N. K. (2015). The Effect of Audio Media-Assisted Practice Learning on Motor Ability and Early Childhood Learning Motivation. Ganesha University of Education Graduate Program E-Journal.

DeCaro, DA, DeCaro, MS & Rittle-Johnson, B. (2015). Achievement motivation and knowledge development during exploratory learning. *Learning and Individual Differences*. 37 (2015), 13-26

Fauziah, AY, & Pradipta, RF (2018). Implementation of the Sociodrama Method in Sharpening the Pronunciation of Sentences for Class XI Deaf Children. *Journal of ORTOPEDAGOGIA*, 4(2), 82-86.

Fitriyah, C & Rahayu, AZ (2013). Self-concept in blind youth at the Blind Children's Education Foundation (YPAB) Surabaya. *Journal of Psychological Research*, Vol. 04, No. 01, 46-60.

Gottfried, AE & Hudley, C. (2008). *Academic motivation and the culture of school in childhood and adolescence*. New York: Oxford University Press

Hadi, P. (2005). *Blind independence: academic orientation and social orientation*. Jakarta: Ministry of National Education

Hersh, MA & Johnson, MA (Eds.). (2008). *Assistive technology for visually impaired and blind people*. Springer: London.

Herrhyanto, N., and Changeni, T. (2009). *Introduction to Mathematical Statistics*. Bandung. Yrama Widya

Kennedy, LM, Tipps, S. & Johnson, A. (2008). *Guiding children's learning of mathematics*. California: Thomson Wadsworth.

Kyriacou, C. (2009). Effective teaching in school: theory and practice (3rded.). London: Nelson Thornes Ltd. Lin, H., Chen, W. & Nien, S (2014). The study of achievement and motivation by e-Learning, a case study. *International Journal of Information and Education Technology*, Vol. 4, No. 5, October 2014, 421-425.

Mani, MNG, at.al. (2005). *Mathematics made easy for children with visual impairment*. Philadelphia: International Council for Education of People with Visual Impairment (ICEVI)

Mawaddah, S., & Anisah, H. (2015). Students' mathematical problem solving abilities in learning mathematics using generative learning models in junior high schools. *EDU-MAT: Journal of Mathematics Education*, 3(2).

Rafikayati, A., Sambira, S., & Muhyi, M. (2020). Development of Audio Teaching Materials in Online Learning for Blind Students at PGRI Adi Buana University. *Journal of ORTOPEDAGOGIA*, 6 (2), 120-124.

Rahayu, A. (2012). *The effect of learning media with power point on the achievement of competence in making men's shirt patterns at SMK Negeri 1 Pengasih. Essay*. Yogyakarta. FT UNI.

Retnawati, H., Prajitno, E. & Hermanto. (2015). Developing mathematics textbooks for the teaching to hearing impaired students of junior high school. *The Online Journal of Counselling and Education*, 4 (3), 111-127

Riduwan. 2013. *Measurement Scale of Research Variables*. Bandung: Alphabeta

Roe, J & Wesbter, A. (2003). *Children with visual impairments, social interaction, language and learning*. New York: Routledge

Romdhiana, YF, & Sugiman, S. (2021, February). *Mathematical Imagination Skills for Blind Students of SMPLB in Joyfull Learning Assisted by Audio Geobraille Media*. In PRISMA, Proceedings of the National Mathematics Seminar (Vol. 4, pp. 446-454).

Rosalina, CD (2020). Increasing Confidence of Mentally Impaired Students through Semiotic Integrated Learning with Pop Up Book Media. *Dinamisia: Journal of Community Service*, 4 (2), 373-383.

Sadiman, AS (2010). *Media Education: Understanding, Development, and Utilization*, Jakarta: Rajawali Pers

Sullo, B. (2009). *The motivated student unlocking the enthusiasm for learning*. Virginia: ASCD

Windari, F. (2014). Improving Mathematics Problem Solving Ability of Eighth Grade Students of SMPN 8 Padang in the 2013/2014 Academic Year by Using Inquiry Learning Strategies. *Journal of Mathematics Education*, 3 (2).

Whittingham, et. al. (2013). Use of Audiobooks in a school library and positive effects of struggling readers' participatory in a library-sponsored audiobook club. *Research Journal of the American Association of School Librarians*, Vol 16, 2013, 1-18