Jurnal Amal Pendidikan
ISSN-p 2746-4725 | ISSN-e 2721-3668
Vol. 4, No. 3, December 2023, Hal:257-264, Doi: http://doi.org/10.36709/japend.v4i3.67
Available Online at https://japend.uho.ac.id

The Effect of Using Cube and Block Nets on the Results of Visually Impaired Learners

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Received: 06 November 2023 *Revised 20 December 2023* *Accepted: 31 December 2023*

Abstract

Mathematics is a subject that is currently considered to have a high level of difficulty compared to other subjects for students. Especially for blind students. Visually impaired learners experience limited senses of vision that can affect understanding and reasoning about the material of Cube and Beam Spaces taught by educators. In this study, the Cube and Beam Nets media was applied which aims to facilitate students in understanding the material of cube and beam nets by assembling cube and beam nets so that they can form cubes and beams. Research was conducted to determine the learning outcomes of students before and after the use of media. In this study, the method used was quantitative method. The research instrument used in this research is a written test with braille letters combined with embossed paper to bring up the nets of cubes and blocks in the test instrument sheet. The type of research used in this research is *exsperiment* with the research design used, namely *one group pre-test post-test* with research subjects 6 students. The average result of the *pre-test* obtained is 43.3, while the average value of the *post-test* obtained is 85. The data obtained was then analyzed using non-parametric statistical analysis with $_{Zscore}$ = 2.20 greater than Z_{table} = 1.96 with a value of n = 6 (α = 5% so that H_0 is rejected and H_a is accepted). If H_0 is rejected and H_a is accepted, then in the study there is a significant influence before the use of media and after the use of 3-dimensional media nets of cubes and beams.

Keywords: learning outcomes; media nets of cubes and beams; visually impaired.

INTRODUCTION

Mathematics is a subject that requires mathematical thinking with a high level of logic in it. If in its implementation students can properly understand the material taught by educators, it can have a major effect on their learning outcomes. According to (Rochmatika, 2015) teacher teaching skills must be owned so that the learning process is expected to attract the attention of students. Based on susenas data or the success of the national census as cited in (The Ministry of Health, 2014) that the Indonesian population gets a percentage of 2.45% for the category of special needs with blind people. Blind learners according to (Badi'ah, 2016) are individuals who experience visual impairment, thus experiencing limitations and difficulties in carrying out daily activities. In addition, according to (Widyastuti, 2016) Blindness is a condition in which an individual loses his vision as a function. according to (Rahayum, 2015) Blindness can be divided into 2 categories, namely *total blindness* and blindness that still has residual *vision* (*low vision)*. Meanwhile, according to (Atmaja, 2017) there are three categories for the visually impaired based on their visual ability, namely mildly visually impaired (has little visual impairment but can still do normal activities), semi-severely blind (uses aids such as magnifying glasses to see), and severely blind (completely unable to see) Based on the results of Kurniawan's research, (Iwan, 2017) that blindness directly affects cognitive development. The

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identification of basic limitations in blind children can be divided into several areas, namely the level and diversity of experience.

According to (Rumatiningsih, 2020), the challenge that blind children have to face is when they learn math subjects. The physical limitations they have are an obstacle for them to obtain maximum learning results. Difficulty learning math is a result of the conditions they have. Learning difficulty is a problem that causes a student to be unable to follow the learning process as well as other students in general due to certain factors so that he is late or even unable to achieve learning goals. Based on the opinion of (Mutmainah, 2015), that the obstacles encountered by blind students when they learn mathematics are the active role of the visual sense is needed to receive a lot of mathematical material, for example in cartesian coordinate system material, so media is needed that can help replace their visual role.

Due to the limited sense of sight that they experience, blind people are required to be able to maximize other senses that are still functioning, namely: smell, hearing, touch, and others. Students in special schools (SLB), especially blind students in mathematics subjects. The process of learning mathematics in blind students not only involves educators directly, but also requires adequate learning tools, the use of appropriate methods, as well as supporting environmental situations and conditions, educators' understanding of the learning difficulties experienced by blind students, especially the difficulties that arise in learning mathematics. Based on research (Riswandha & Sumardi, 2020) students who perceive mathematics as a relatively difficult subject and form negative impressions and experiences of mathematics generally have a negative impact on academic achievement at school.

Based on observations made at SMPLB YPAB Surabaya, it is known that there are 6 students who are blind in the Low Vision category. Based on field conditions, a problem was found where the lack of low learning outcomes of blind students in learning mathematics. Based on the results of interviews with educators in class VIII at SMPLB YPAB Surabaya that math learning is material that is considered difficult to teach to students. Especially for blind students because the level of learning independence of blind students is still low. During learning, blind students are still assisted by educators or special assistants and volunteers to be able to learn, so that students often experience difficulties in learning.

From the previous statement, it can be concluded that the ideal condition that must be achieved by class VIII students, especially in mathematics, is a significant change in their learning outcomes on the material presented by the teacher. To realize this, media is needed that can support the achievement of the learning objectives to be achieved. The basis of consideration for determining the appropriate media used is based on the objectives to be achieved, the conditions and involvement of students related to the media, as well as the suitability of the material with the media used. The media used in learning is media that can be reached by hearing or touching. This is reinforced by the results of (Saksono's, 2016) research that the help of teaching aids in learning mathematics for blind students can help students in exploring their knowledge independently so as to improve the ability and learning outcomes of students. based on the results of (Murdianto's, 2014) research regarding the creative use of media and teaching aids has a significant effect on students' learning outcomes to be better and can improve their performance in accordance with the objectives to be achieved. This is in accordance with the opinion of (Marliani, 2015), "students who learn by using learning media tend to understand the lessons given by the teacher more easily and explore themselves more quickly to understand math lessons". In addition, it is reinforced by the opinion of (Suwarti, 2015) which states that, "by using mathematical teaching aids, students are more interested in participating in math learning activities, students do not feel bored and bored".

Based on this, 3-dimensional media was chosen because for the characteristics of the space building material studied by blind students, props are needed that can provide a direct description of the material studied to students.

METHODS

In this study, the research design used *was one group pre test and post test design* (single group *pre test* and *post* test). According to (Arikunto, 2019) says that *one group pretest-posttest design* is a research activity that provides an initial test *(pretest*) before being given treatment, after being given treatment, then gives a final test *(posttest).* This one group pretest-posttest design consists of one predetermined group. In this design, tests are carried out twice, namely before and after treatment. The research pattern of the one group pretest-posttest design method (Sugiono, 2018). In addition, the type of data used in this study is quantitative data. According to (Arikunto, 2019) Quantitative data can be in the form of numbers from calculations used as a test of product feasibility and effectiveness. quantitative data can be obtained from based on the pre-test and post-test results. The research subjects used in this study amounted to 6 students who were in class VIII blind at SMPLB YPAB Surabaya which is located on Jalan Gebang Putih No.5 Surabaya City. The subjects studied were students in the category of visually impaired who still had very little residual vision, which only had Light perception.

The data collection instruments used in this research are questionnaires and written tests in the form of braille. The questionnaire was used to collect validation data regarding the feasibility of the material, and the Learning Design (RPP). The questionnaire instrument was given to material experts and learning design experts. In this study, the test used to collect data on the ability of students to measure learning outcomes in learning mathematics cube and beam material.

The pre-test and *post-test* data analysis techniques used in this study are non-parametric statistical data analysis techniques, namely statistical testing carried out because one of the normality assumptions cannot be met. The number of samples is small, the subjects studied are less than 30 students, so the data can be analyzed using the *Wilcoxon Match Pairs Test* formula to test the significance of the comparative hypothesis of two correlated samples when the data is ordinal (tiered). The *Wilcoxon* marked level test (auxiliary table) is used to make it easier for researchers to find differences in the ability to understand the material of the nets of cubes and beams in blind students at SMPLB-A YPAB Surabaya by using the media nets of cubes and beams.

RESULTS AND DISCUSSION

Based on the results of the questionnaire that has been validated by experts, the results of the validation test are as follows: validation of learning design obtained 98% including excellent category, validation of material by material expert I obtained 99% including excellent category, validation of material by material expert II obtained 98% including excellent category, the average is included in the excellent category. From the results of the validation of the experts, it can be concluded that the three-dimensional media of the nets of cubes and beams learning mathematics is feasible and has met the criteria to be used as learning media for blind students in grade VIII at SMPLB-A YPAB Surabaya.

Data collection begins with giving pre-test questions to students in writing to determine the initial ability of students to understand the material that has been delivered by educators. The pre-test results can be seen in table 1 below

Table 1. Pre-test result data

Learner's name	*Pre-test* score
SA	40
MISP	40
FV	50
HS	30
WNF	60
GRT	40
Average Pre-test Score	260:6 = 43,3

Based on the results of the pre-test, it can be concluded that the understanding of blind students in class VIII SMPLB-A YPAB Surabaya on the material of the nets of cubes and beams needs to be improved. So it can be concluded that students need media to increase understanding of the material of the nets of cubes and beams. The next step is to conduct a post test to determine the ability of students to understand the material of the nets of cubes and beams after being given treatment with the media of the nets of cubes and beams using a direct learning model. Post-test data on the ability to understand the material of the nets of cubes and beams of students in class VIII SMPLB-A YPAB Surabaya in table 2 below

Table 2. *Post-test* result data

Learner's name	*Post-test* score
SA	70
MISP	80
FV	90
HS	80
WNF	100
GRT	90
Average Post-test Score	510:6 = 85

Based on the results of the *post-test*, it can be concluded that the ability of blind students at SMPLB-A YPAB Surabaya in understanding the material of the nets of cubes and beams has increased after being given treatment using three-dimensional media nets of cubes and beams. The average value before being given treatment was 43.3, but after being given treatment using three-dimensional media nets of cubes and beams the average value was 85. Furthermore, the *pre-test* and *post-test* data were analyzed to determine the ability of students to understand the material. and as an intermediary to determine the T value (number of levels).

Table 3. Comparison of pre-test and post-test of learners' ability

No.	X_A *(Pre-test)*	X_B *(post-test)*	Beda $(X_B - X)_A$	Level mark		
				Level	+	-
1.	40	70	30	1	1,0	0
2.	40	80	40	3,0	3,0	0
3.	50	90	40	3,0	3,0	0
4.	30	80	50	5,5	5,5	0

No.	X_A *(Pre-test)*	X_B *(post-test)*	Beda $(X_B - X)_A$	Level mark		
				Level	+	-
5.	60	100	40	3,0	3,0	0
6.	40	90	50	5,5	5,5	0
		Total			T+ = 21	T- = 0

The results of the *pre-test* and *post-test* that have been analyzed above are the data obtained in the research that has been reprocessed using data analysis techniques intended to obtain research data conclusions. The analysis used by researchers is data using the *Wilcoxon* formula, with the following calculations.

$$Z = \frac{T - \mu T}{\sigma T} = \frac{T - \frac{n(n+1)}{4}}{\sqrt{\frac{n\,(n+1)(2n+1)}{24}}} \quad \text{.....(1)}$$

Description: Z= Statistical test result value signed rank test; T= Smallest sign value, μ_T = Mean (average value) = $\frac{n(n+1)}{4}$, σ_T = Standard deviation = $\sqrt{\frac{n\,(n+1)(2n+1)}{24}}$, n= Number of samples; p = probability of obtaining the sign (=) and (-) = 0.5 due to 5% crisis.

The data calculation is as follows. It is known that n=6, then μ_T = Mean (average value) = $\frac{n(n+1)}{4} = \frac{6(6+1)}{4}$ = 10,5. σT = Standard deviation = $\sqrt{\frac{n(n+1)(2n+1)}{24}} = \sqrt{\frac{6(6+1)(2x6+1)}{24}}$ = 4,77. The mean (μ_T) = 10.5 and the deviation (σ_T) = 4.77 when entered into the formula will get the following results: $Z = \frac{T - \mu T}{\sigma T} = \frac{T - \frac{n(n+1)}{4}}{\sqrt{\frac{n\,(n+1)(2n+1)}{24}}} = \frac{0-10,5}{4,77}$ = 2, 20

Based on the data analysis above, the hypothesis on the results of the 5% crisis calculation with decision making using two-party testing because the aim in this study is to test whether or not there is a difference between variable X and variable Y, α 5% = 1.96 where n = the number of samples totaling 6 children is H_a accepted if $Z_{score} > Z_{table}$ 1.96 and H_0 accepted if Z_{score} 2.20 < Z_{table} 1.96. Then the comparison picture of the two-party hypothesis testing curve between the table value and the calculated value is as follows.

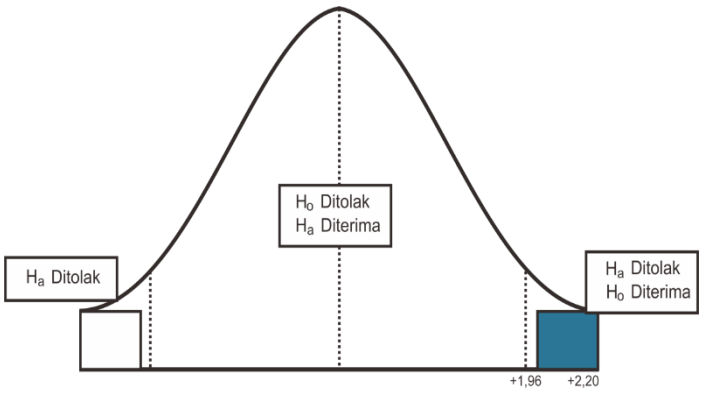

Figure 1. Two-Party Hypothesis Testing Curve

According to (Sugiono, 2018), a two-party test is used if the no hypothesis (Ho) reads "equal to" and the alternative hypothesis (Ha) reads "not equal to" (Ho =; Ha≠). In this study, researchers used two-party testing which is intended to test two sides, namely Zh (Z_{score}) and Zt (Z_{table}). In addition, the processed sign test also produces a positive sign on all research subjects and does not produce a negative sign. So it can be concluded that by applying three-dimensional media the nets of cubes and beams are very effective in the learning process at SMPLB-A YPAB Surabaya and the learning outcomes of students have also increased.

These results are reinforced by several related studies, including research conducted by (Saksono, 2020) that using 3-dimensional media or teaching aids has a significant influence in helping blind students to connect understanding of the material taught by the teacher by utilizing existing media, so that students have an idea of what problem-solving concepts are in accordance with the problems given by the teacher to solve. Learning with manipulative teaching aids is a lesson that provides a tool where its use is integrated with the objectives and content of the lesson: (a) teaching aids can overcome differences in student experience; (b) teaching aids can generate a new spirit of learning and generate motivation and stimulate student activities in learning; (c) teaching aids can affect abstraction; and (d) teaching aids can introduce, correct, improve, and clarify the understanding of concepts and facts. In addition, based on research (Binangun, 2016), based on the results of his research stated that, "the results of research that the use of teaching aids can improve math learning outcomes and student activeness in applying concepts". In general, in every implementation of mathematics learning, it is necessary to choose the right strategy, including the selection of teaching aids. In addition, reinforced by the results of research assisted by teaching aids, the level of understanding of students' mathematical concepts is expected to increase. In addition, based on research by (Munif, Susanto, & Susilo, 2016) that by using learning aids in the implementation of the teaching and learning process can take place in an interesting manner and be able to involve the active participation of students which in turn will increase student achievement.

CONCLUSIONS

Based on the results of research and data analysis that has been carried out, it can be concluded that researchers have succeeded in using three-dimensional media nets of cubes and beams learning mathematics for blind students in class VIII at SMPLB YPAB Surabaya. The results of the validation test to several experts as follows: validation of learning design obtained results 98% including excellent category, validation of material by material expert I obtained results 99% including excellent category, validation of material by material expert II obtained results 98% including excellent category, the average is included in the excellent category. From the results of the validation of the experts, it can be concluded that the three-dimensional media of the nets of cubes and beams learning mathematics is feasible and has met the criteria to be used as learning media for blind students in grade VIII at SMPLB-A YPAB Surabaya. In addition, from the results of data analysis, the three-dimensional media nets of cubes and beams of mathematics learning for blind students in class VIII at SMPLB-A YPAB Surabaya, the results showed that the use of three-dimensional media nets of cubes and beams had a significant effect on the ability of blind students in class VIII to understand the material of the nets of cubes and beams. This is based on the results of the average pre-test value of 43.3. while the post-test value is 85. The average value shows that the post-test value carried out after the application of three-dimensional media nets of cubes and beams learning is greater than the pre-test conducted before the application of three-dimensional media nets of cubes and beams in learning. Based on the results showed that $Z_{score} = 2.20$ is greater than $Z_{table} = 1.96$ with a crisis value of 5% with n = 6, then $Z_{score} = 2.20 > Z_{table} = 1.96$ If H_0 is rejected and H_a is accepted, then in the study there was a significant influence before the use of media and after the use of media 3 dimensional nets of cubes and beams.

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