

## **Implementation of Braille Code Coordinate Board Media in Learning Mathematics of Cartesius Coordinate Systems for Visual Impairment Students**

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**Abstract.** The purpose of this study was to study student achievement in studying the material of the Cartesius coordinate system using a braille-coded coordinate media. This type of research is a single subject research (SSR) reversal design A-B which consists of two phases, namely the baseline phase and the intervention phase. The methods used to collect data are interviews, learning achievement tests, and documentation. The instrument used was interview guidelines and test questions. Data analysis techniques with descriptive statistical analysis. The results of the analysis in the conditions at the baseline phase obtained a change of +2, and the conversion phase obtained a change of +14. The results of analysis between conditions obtained by data overlap by 0%. This is a very good phase of change. By using braille-coded coordinate media, visual impairment students can order materials for the Cartesius coordinate system more easily.

**Keywords:** mathematics learning, learning media, braille, and visual impairment.

### **1 Introduction**

Every human being would expect to be born with a perfect physical state. No one wants to be born disabled. One type of disability that is of most concern to the world is blindness. In 2012 WHO wrote there were 285 million people are visually impaired worldwide, one-third of the 285 million blind people in the world located in the ASEAN countries and the number of blind people in Indonesia is the highest in the ASEAN region [1]. In Indonesia, someone who has visual impairment is called visually impaired. According to the Large Indonesian Dictionary (KBBI), the blind are unable to see or are blind [2]. Often people think that the blind is someone who can not see at all, but not so. The visually impaired can be classified into two categories namely low vision and blind [3]. Medically a person is said to be visually impaired if he has vision 20/200 or has a vision of fewer than 20 degrees, and when viewed from an educational perspective, a child who is said to be visually impaired if the media used to participate in learning activities is a sense of touch [4]. So it can be concluded that the visually impaired is an individual whose sense of sight (both) cannot function properly to obtain all the visual information in daily life like an alert person.

Vision is the instigator of thought, not its handmaiden. Neural tissue developed to use of incoming visual information [5]. The basic element of visual communication is everything that can be seen and can be used to convey meaning, meaning, and message. With visual impairments suffered by blind people so they are not able to receive visual information with

their sense of sight. Sense of vision has an important role for humans to understand their environment. "It is now accepted that 90 percent of the information is gained through the visual sense and only 10 percent from the other four remaining senses" [6]. Therefore, a blind person must use the remaining senses they have to obtain the information they need. In everyday life, blind people use braille codes as their written communication tool. Braille is a writing system that enables blind and partially sighted people to read and write through touch [7]. This allows visually impaired people to read and write using touch instead of vision [8]. Thus, someone who has a visual impairment can still gain knowledge and knowledge by reading.

A country is not allowed to distinguish each of its citizens in terms of educational attainment. This is stated clearly in the 1945 Constitution of the Republic of Indonesia article 31 paragraph 1 that every citizen has the right to receive education [9]. Government regulations that seek to provide educational justice for children with special needs are also contained in Law No. 20 of 2003 concerning National Education System article 32 states that special education (special education) is education for students who have difficulty in following the learning process due to physical, emotional, mental, social disorders [10]. The mandate of the Act is a strong foundation for blind students to get the same education as normal students.

Learning objectives can be achieved optimally with the support of adequate educational facilities and infrastructure. With the visual limitations possessed by visual impairment students, of course, they need learning media to visualize every material provided by teachers at school. One subject that requires media (teaching aids) in the delivery process is mathematics. Mathematics is an abstract science that tends to require quite a high reasoning, so the use of mathematics learning media will help students understand mathematical concepts. Mathematics learning media is a tool for students to deliver mathematical materials to real form with the basic form to understand the use of mathematics, which is not merely to memorize [11]. The media used instructional in teaching and learning can generate desire and new interests, raise motivation and simulation of learning activities and bring psychological effects on students [12]. The available media should be by students' characteristics. For visual impairment students, to replace the role of the sense of sight they use their remaining senses, namely maximizing the sense of touch and the sense of hearing [13]. Based on this, it is very much needed media that is centered on maximizing the senses of blind children who are closely related to their senses of touch, namely in the form of braille-coded learning media. Braille coded learning media is a tool used to convey material assisted with numbers and braille letters. Thus, blind students will find it easier to learn the material provided by the teacher using the media.

The process for learning mathematics certainly begins with the material visualization stage. This will be the main difficulty faced by blind students. The most frequent mathematical problems of blind pupils are as follows: generalizing - finding the similarities in different activities in everyday life, translating activities and actions into mathematical language, lacking flexibility in problem-solving and calculations, and translating and transferring three-dimensional objects into two-dimensional iconic forms [14]. The difficulty in learning mathematics faced by blind students is one of them in the Cartesian coordinate system material. Based on interviews conducted with mathematics teachers at the Muhammadiyah Purworejo Special School (SLB), it was found that the learning achievement of blind students in the Cartesian coordinate system material was still low and had not yet reached the Minimum Mastery Criteria (KKM). This is because the media used by visual impairment students is the media used by normal students. Therefore, the researcher wants to know the learning achievement of visual impairment students in the Cartesian coordinate system material after using braille-coded coordinate media.

## **2 Method**

This research is an A-B reversal design Single Subject Research (SSR) experiment consisting of two phases, namely the baseline phase (A) and the intervention phase (B). The subject of the research was a VI blind class student. When this research was conducted on May 10, 2019, to May 24, 2019, which was located in SLB Muhammadiyah Purworejo. The research methods used were interviews, test questions, and documentation. As for the research instrument in the form of interview guidelines and test questions.

Single-subject research with A-B design is the basic design of single-subject experiment research. The main procedures adopted in the A-B design include the measurement of the target behavior (research subjects) in the baseline phase and after the trend and the data level is stable then intervention is given [15]. In carrying out measurements in each phase at least 3-5 times (until trends and data levels are known). If there is a change in the target behavior in the intervention phase compared to the baseline phase, it is assumed that the change is caused by the intervention. This research did not repeat the baseline phase after the intervention was given because the research activities carried out by the target behavior were in the form of practice. So that changes that occur in the immediate subject can be seen in the intervention phase.

Data analysis techniques performed by researchers in the form of descriptive statistical analysis. In the analysis of this single-subject research data there are several things that need to be a concern of researchers, namely, the number of data points (scores) in each condition, the number of dependent variables to be changed, the level of stability and changes in the level of data in a condition or between conditions, and the direction of change in conditions or between conditions [16]. The research procedure carried out by researchers is initiated by conducting interviews with mathematics teachers at SLB Muhammadiyah Purworejo to obtain information related to mathematics learning achievement of blind students. After knowing the problems experienced by blind students in SLB Muhammadiyah Purworejo, the researchers began the research by entering the baseline (A) phase. This baseline phase is carried out until stable data is obtained (fixed) then concluded by giving test questions to the subject. After the researcher has obtained stable data in the baseline phase, the researcher can continue to the next phase, the intervention phase. This intervention phase is carried out until stable data is obtained and then it is ended by giving test questions to the subject. From the data obtained during the baseline and intervention phases, an analysis of conditions and inter-condition analysis is carried out to determine changes in the target behavior.

## **3 Research Result and Discussion**

### **3.1 Research Result**

This research was conducted at SLB Muhammadiyah Purworejo. Based on the results of the interview, the research subjects had difficulty in studying the Cartesian coordinate material system, thus causing the subject's low learning achievement. This is caused by the mismatch of the mathematics learning media used by blind students. Data generated from this study were obtained from two phases, namely the baseline phase (A) and the intervention phase (B). This baseline (A) phase was carried out in 4 sessions. The data in the baseline phase (A) was obtained through tests given to subjects at each session. Recap of the subject values in the baseline (A) phase can be seen in the following table.

**Table 1.** Baseline Data (A) Research Subject

Session	Sum of essay	Total Score	Score	Percentage
1	4	20	0	0
2	4	20	2	10
3	4	20	2	10
4	4	20	2	10

After the data is stable in the baseline phase (A), this phase can be stopped and continued to the intervention phase (B). At each intervention phase, the subject was given a treatment of learning mathematics using the media braille coded coordinate board, then the ability of the subject regarding the Cartesian coordinate system was measured using that media. This intervention phase lasts for 4 sessions. Obtaining a subject score in the intervention phase can be seen in the following table.

**Table 2.** Intervention Data (B) Research Subjects

Session	Sum of Essay	Total Score	Score	Percentage
5	4	20	6	30
6	4	20	18	90
7	4	20	20	100
8	4	20	20	100

The lowest score is 6 or 30% ie in the fifth session. The highest score is 20 or 100% in the seventh session and lasts until the eighth session. Seeing this situation, the researchers decided to end the given intervention phase.

Overall data in the research process is shown in the following graph.

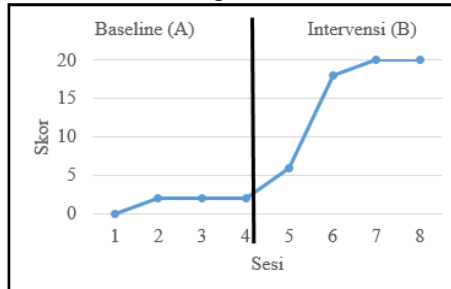


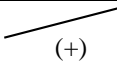
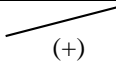
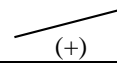
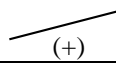
Fig. 1. Overall A-B Process

When compared between the baseline phase (A) and the Intervention phase (B) a significant increase will be seen. In general, in the baseline phase (A) the subject is only able to determine the location of points in the coordinate plane. Whereas in the Intervention phase (B) the subject was able to determine the shape of the flat shape and the reflection of points and flat shapes.

### 3.1.1 Analysis in Conditions

The results of the acquisition scores in the baseline and intervention phases are used to carry out analyzes in conditions and between conditions. Analysis of conditions includes the length of conditions, direction trend estimation, stability trends, data-trace, level stability range, and level of change. The components of visual analysis in this condition are summarized in the following table.

**Table 3.** Analysis Results in Conditions

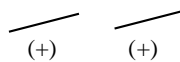
Conditions	A	B
Long Condition	4	4
Estimate Direction Trend		
Trend Stability	Variable (25%)	Variable (0%)
Data Traces		
Range Stability Level	Variable (0-2)	Variable (6-20)
Level of Change	(+2)	(+14)

From the summary of the analysis results in the above conditions, it can be concluded that there are differences from the baseline phase (A) and the intervention phase (B). The baseline and intervention phases were carried out for 4 sessions each. The tendency of direction in both phases is positive and tends to increase. The increase can also be seen from the level of change that occurred in the baseline phase +2 and the intervention phase of +14.

### 3.1.2 Inter Condition Analysis

Analysis between conditions includes the number of variables changed, changes in direction and effect, changes in stability, level changes, and percentage overlap. The components of visual analysis between these conditions are summarized in the following table.

**Table 4.** Inter-Condition Analysis Results

Change in Conditions	B/A
Sum of Variables Changed	1
Change Trend Direction and The effect	
Change Trend Stability	Variable to Variable
Level Change	(+4)
Percentage Overlap	0%

From the summary of the results of the analysis between the conditions above it can be concluded that there is an influence of the intervention given to the research subjects. The tendency of direction in both phases is positive and tends to increase. A level change of +4 occurred from the baseline phase to the intervention phase. Evidence that shows the influence of the interventions provided is derived from the overlap percentage of 0% which means that the intervention has a very good effect.

### 3.2 Discussion

The results of this study indicate that a blind student will maximize the sense of touch to learn something. They will use the senses of touch as an eye to visualize the information they get. This is supported by the opinion of Winantyo and Azizah which states that the inability of blind children to see, results in other senses of blind children become more sensitive. One of them is the tactual senses [17].

The learning achievement of students with visual impairments on the Cartesian coordinate material system is still low because the media used do not suit their needs. Existing media should be easily touched and equipped with braille codes to make it easier for blind

students to learn the material. This is in line with the results of research from Usnawa, et al. which says that braille boxes can enhance the ability of reading comprehension, so that the information contained in a reading will be faster remembered and understood by blind children the ability to touch children in displaying a word in a reading [18]. Learning media used by students must be by student needs because it can affect student learning achievement. This is consistent with the results of research from Guswiani, et al. which states that the application of instructional media has a positive impact on the development of achievement of learning goals [19]. That is because the variables that influence the learning success system are: 1) teacher factors, 2) student factors, 3) facilities and infrastructure factors, and 4) environmental factors [20].

The application of the braille-coded coordinate media is used to study the Cartesian coordinate system material. In the baseline phase, each session students are asked to work on questions to measure students' initial ability to the material using the media that is commonly used. Judging from the implementation of this phase students are still confused to determine the location of points, mirroring points and mirroring shapes in the coordinate plane, and determining the flat shapes in the coordinate plane. The subject had difficulty imagining the shape of the coordinate plane and it was difficult to feel from one point to another because the path between points on the media was not felt when touched. Then in the intervention phase, each session the students were given a problem that was done using the media braille coded coordinate board. In the intervention phase, the subject has been able to determine the location of points, the results of mirroring points, flat shapes formed from known points, and mirroring of flat shapes on the coordinate plane.

#### **4. Conclusion**

Based on the results of the research and discussion above, it can be concluded that the implementation of the braille-coded media board given to blind students in the Cartesian coordinate system material influences student learning outcomes. In the baseline phase, the subject can determine the location of points on the plane of the Cartesian coordinates with the highest score reaching 10%. In the intervention phase, the subject can determine the location of points, flat shapes, mirror points, and mirrored flat shapes in the plane of the Cartesian coordinates with the highest score reaching 100%. The results of the analysis in the conditions showed a significant change in the level of +2 in the baseline phase and increased to +14 in the intervention phase. Then, based on the results of the analysis between conditions, the results of overlapping data were 0%. This shows that the intervention given to the subject (target behavior) gives a very good influence.

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