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Collaborative Teaching in Magnetic Field Lesson for Students with Deaf and Hard of Hearing (DHH)

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Abstract--- *The aims of this study to find out how to teach the magnetic field lesson to students with deaf and hard of hearing (DHH). The study used a single-subject research approach with A-B design (baseline and intervention) in senior high school Banjarmasin. The subject of this study consisted of three students with DHH. The results of the study revealed that the magnetic field lesson can be mastered by students with DHH. This success is due to the division of tasks or collaboration between special teachers and regular teachers. When the regular teacher explains with media, a special teacher plays a role in translating to Sign Language. Not all instructions are translated but only instructions that difficult to understand because basically students with DHH can understand from writing and read the regular teacher's lips movement. Another factor that shapes an understanding of students with DHH is the student's seating position. Inappropriate positions, students with DHH can see regular teacher's face clearly and help them to read regular teacher's lips movement. Essentially, students with DHH use their visual abilities to learn.*

Keywords--- *Students with Deaf and Hard of Hearing (DHH), The Magnetic Field Lesson, Collaboration, Regular Teachers, Special Teachers.*

I. INTRODUCTION

Magnets have long been known to humans. The concept of magnetism begins with the appearance of a rock that can draw small pieces of iron. Magnets were first discovered in the Asia Minor area. The term magnet was discovered by the Greeks from an area called Magnesia. Many kinds of literature published for navigation began in the 12th century [1].

The benefits of magnets are enormous for human life for navigation tools. The magnetic compass has an important role in various interactions [2]. Using the magnetic properties of the earth. A compass is a good tool for completing magnetic fields.

The lesson about magnetism is part of the secondary school curriculum. The discussion of magnetic atoms is very complicated but can be adapted in the form of algebra for secondary schools [3]. Teachers must be able to present science learning that is interesting to students. Concrete learning can increase understanding and reduce verbalism [4]. Good student interest supports the success of learning.

There have been many studies on magnetism. Research findings, especially magnetic fields, have made a lot of progress. Reis's writing on "fundamentals of magnetism" provides a foundation for researchers at the graduate level [5]. Parkinson's and Farnell's research presents a recent survey of concepts and theories in the fields of magnetism, relevance, experimentation and real material [6]. The study conducted by Anugrah et al discussed the making of magnets by induction [7]. Another study conducted by Adipura et al. also discussed magnetic induction

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[8]. Research at the stage of the learning process of magnetic field lessons in secondary schools is still lacking.

The interest in the magnetic field lesson needs to be increased at the secondary school level. According to the Musriyah research, the motivation and learning outcomes of magnetic field lesson in Vocational High Schools are still low [9]. Researches on magnetism will emerge if interest in this lesson is greater. Experimental demonstration methods can improve learning activities [10]. This activity can begin with meaningful learning in the classroom. The experimental demonstration method can be used to achieve that goal. Martini's research shows that 100% of students stated that the experimental demonstration method was very pleasant [11]. The introduction of basic magnetic concepts can make students explore the parts that will be studied. The experimental demonstration method begins with giving examples then students carry out demonstrations [12].

DHH students experience obstacles in the auditory. They have challenges in language development especially verbal language [13]. DHH is a condition in which a person experiences a partial or total loss of hearing instrument function [14]. They have hearing levels that are below regular students. DHH students have academic achievements left behind from other students due to lack of information from hearing [15]. The stimulus in the form of sound cannot be received properly. They need chasing modifications that accommodate their needs [16]. DHH utilizes a visual learning style. They have different thinking styles [17]. Information is mostly obtained through the sense of sight.

Schools that accept DHH students must conduct conditioning. There is a lot of debate about DDH adoption and affecting their quality of life [18]. Seating arrangements can help DHH students. Seating position influences learning motivation and learning achievement [19]. The teacher's instructions must be clear from both lips and writing. Special teachers assist in repetition using sign language. Research in Sweden mentions that teaching in sign language supports the ability of DHH [20]. DHH students need to master at least one language to reach their full potential [21]. Other students need to know the right way to collaborate and interact with DHH students in a group task.

II. Logical Framework

Each magnet has a certain tensile force. This style will be following the strength of the magnet itself [22]. Areas that are affected by magnetism are called magnetic fields. This region is not visible but can be described. The breadth of the magnetic field illustrates the magnitude of the magnetic force [23].

The magnetic force lines are straight lines that are in a magnetic field. This line connects the north pole and south pole of the magnet. The characteristics of the magnetic force line include:

1. The magnetic force line shows the direction of leaving the north pole towards the south pole of the magnet.
2. The magnetic force lines never intersect
3. The more closely the lines of the magnetic force, the stronger the magnetic field and the more tenuous magnetic lines show the weaker the magnetic field.

The strongest magnetic force is at the magnetic poles. The more away from the magnetic pole, the magnetic force will decrease. The equation for the magnetic field strength produce by a long straight current-carrying wire is:

$$B = \frac{\mu 0 I}{2\pi r} \quad (1.1)$$

For along straight wire where is the current, r is the shortest distance to de wire, and the constant 0= $4\pi r10^{-7}$(T.m)/A is the permeability of free space. $\mu 0$ is one of the basic constants in nature, related to the speed of light.

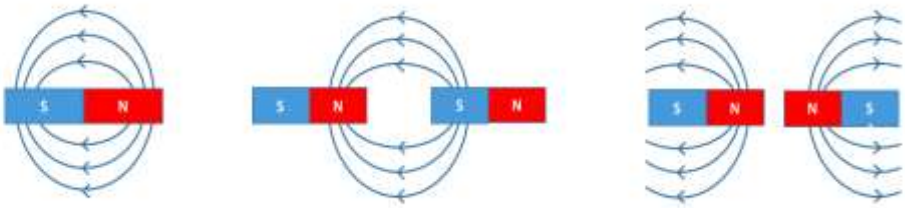

Fig. 1. The Direction of the Magnetic Field

III. RESEARCH METHODS

2.1 Research Subjects

The research method uses a single subject research approach. The subjects of this study were two DHH students in secondary school Banjarbaru South Kalimantan Indonesia. The identity of participants in this study used the initials A and B. Teaching experimental demonstrations were conducted to facilitate understanding of the magnetic field lesson in DHH students. The collaboration of regular teachers and special teachers to promote inclusive education in schools.

An overview of participants' abilities is obtained through some data collected [24]. A complete description of the child's ability will make it easier for authors to do data analysis. The authors collected demographic data and assessment of learning outcomes (Mathematics, Physics and Bahasa). Demographic data consists of IQ, attention and motoric abilities of students. Demographic data and learning outcomes were obtained from interviews with teachers. The results of demographic data and learning outcomes were analyzed to determine the level of DHH students. The score scale is set from 1 (very low), 2 (low), 3 (medium), 4 (high), 5 (very high).

2.2 Teaching Conditions

Teaching is carried out for five meetings. The first and second meetings were conducted to pre-test the understanding of the magnetic field lesson as baseline data. The third meeting until the fifth meeting was conducted with experimental demonstration teaching as an intervention. Each teaching experimental demonstration ends with a post. There are five questions about understanding the magnetic field that must be answered during the pre-test and post-test.

Teaching magnetic field lesson begins by placing DHH students on three conditions. The first condition of DHH students is placed in the rear seat position. The condition of the two DHH students is placed in a seating position in the middle. The condition of the three DHH students is placed in the seat position in front. This test is conducted to determine the impact of a seating position on understanding the lesson.

2.3 Experimental Demonstrations

Teaching experimental demonstrations were conducted in three meetings. Each meeting begins with an explanation of the concept of the magnetic base for 15 minutes. The next meeting was introduced tools and materials to be used in an experimental demonstration for 15 minutes. The implementation of a magnetic field experiment was carried out 30 minutes. Materials needed during the experiment are magnets, iron powder and paperboard. Magnets used in the type of rod size 37x8x5mm. The magnetic part is red as the north and blue poles as the south pole. The iron powder provided is 130 grams. The iron powder size is 850 micrometers. Cardboard paper used A4 size 210x297mm.

The experimental procedure carried out as follows (a) put the magnet under the cardboard. (b) sprinkle the iron powder on cardboard (c) tap the paperboard slowly (d) move the magnet around the paper (e) keep the magnet away from the paper. (f) observe the pattern of iron powder formed.

IV. RESULTS AND DISCUSSION

3.1 Demographic Data of DHH Students

Figure 2 informs the DHH demographic data. the information shown is the level of intelligence, attention, motoric development, and visual perception. Academic performance is influenced by IQ factors [25]. Visual perception ability is needed by DHH students to process teaching stimulus [26]. Motoric development greatly influences the process of student interaction when learning [27]. This information is obtained from the interview process with the teacher. Data collected will be used to make preliminary conclusions regarding the ability of DHH children. This demographic data provides an overview of prerequisite ability before accepting experimental demonstration intervention. This capability will certainly have an impact on DHH during the learning process.

Student A has a level of intelligence that is at a score of 4. This score indicates that children's intelligence is high. The intelligence level of DHH students is the same as students who do not experience DHH and even higher. The quality of life of DHH students is almost the same as other students. Student A does not experience problems in receiving and processing information. The data regarding attention shows a score of 3, meaning the ability of students to focus on an object at a moderate level. Students can respond to the stimulus information provided by the teacher. The motoric development of student A is at a score of 3, indicating a moderate level of ability. Student motor activities do not experience problems. The visual perception ability of student A shows a score of 4, meaning that students are at high ability. Visual information can be understood by students quickly.

Student B has an IQ level of 3. The IQ picture of students shows moderate ability. The ability of children to receive and process information does not experience problems. The level of student intelligence is the same as students who do not experience DHH. The level of attention of children is also at a moderate level which is indicated by a score of 3. Students do not have problems with the information stimulus provided by the teacher. Motoric development of student B shows a score of 4, meaning that the ability is high. Student B has advantages in physical activity. The visual perception ability of students shows a moderate level with a score of 3. This means that visual information is given, students B can receive it well.

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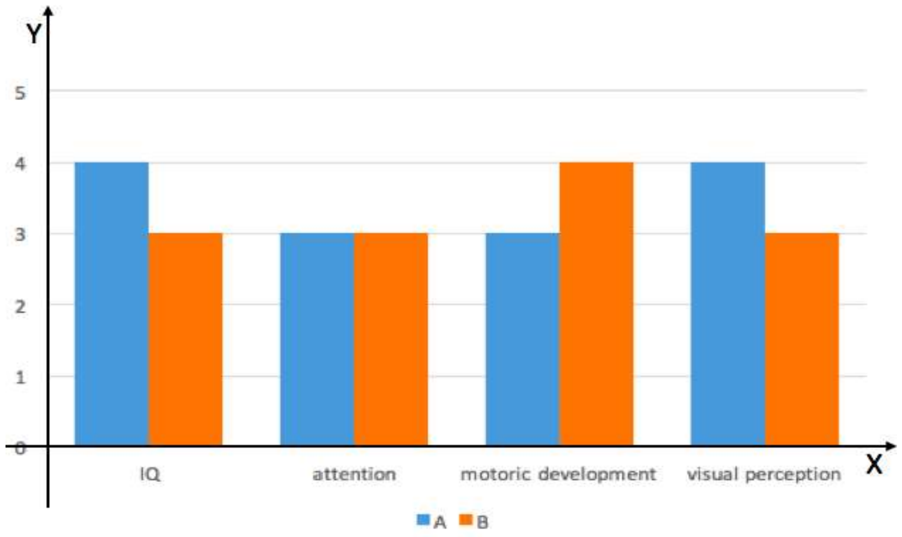

Fig. 2. Demographic data of DHH students

Figure 3. Shows the level of understanding of DHH students in subjects in school. The subjects observed included mathematics, physics and Indonesian. This information will be compared with students' abilities in understanding a magnetic lesson. The researcher will see in full the relationship between the two data obtained.

Student A shows ability in mathematics with a score of 3. Mathematical abilities are at a moderate level. The student has the same level of understanding with other students who do not experience DHH. Students' understanding of physics shows a score of 3, meaning that it is at a moderate level. Understanding physics students is the same as children who do not experience DHH. The ability of students A in Indonesian language courses is at a low level with a score of 2. That is, the level of students' understanding of Indonesian is weak.

Student B shows mathematical abilities with a score of 2. Students' understanding is low in mathematics. Students' physics subjects score 2, meaning that their understanding is also at a low level. Students B have a low level of understanding in Indonesian language courses. Student B gets a score of 2 in this subject.

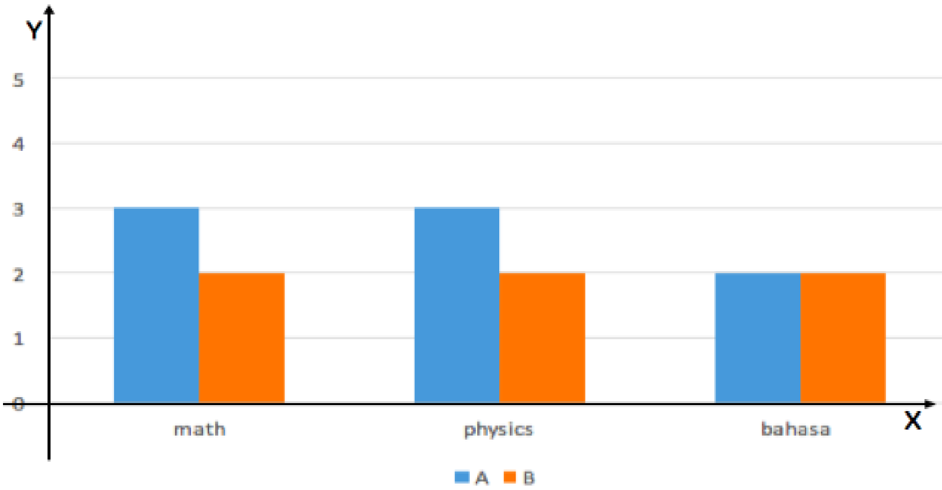

Fig. 3. The Understanding Level of DHH Students on Subjects

3.2 Teaching Magnetic Field Lesson to DHH Students

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Teaching experimental demonstration methods are designed based on the demographic data of DHH students. Data on IQ levels, attention, motoric development, and visual perceptions show the position of DHH students seen from developmental aspects. Data on understanding subjects, namely mathematics, physics and Indonesian language describes the level of DHH students in academic aspects. The experimental demonstration method adjusts the developmental aspects and academic abilities of DHH students.

The magnetic field of a log straight wire has more implications than one might first suspect. Each segment of current produces a magnetic field like that a long straight wire and the total field of any shape current is the vector sum of the field due to each segment. The formal statement of the direction and magnitude of the field due to each segment is called the Biot-Savart law. Integral calculus is needed to sum the field for an arbitrary shape current. The Biot-Savart law is written in its complete form as:

$$B = \frac{\mu 0 I}{4\pi} \int \frac{dl \times r}{r^2} \quad (1.2)$$

where the integral sums over the wire length where vector *dl* is the direction of the current; *r* is the distance between the location of *dl* and the location at which the magnetic field is being calculate; and *r* is a unit vector in the direction of *r*.

The level of development of DHH students basically does not experience problems. The difference with other students lies only in the use of the more dominant sense of sight. DHH students have problems with audio information. Collaboration between regular teachers and special teachers is also needed to ensure that information is received by DHH students properly. Public teachers deliver teaching with verbal and written. Special teachers deliver individual reinforcement through sign language and writing.

The results of the study show that magnetic field lessons can be taught to DHH students. The IQ level of DHH students who were the subjects of the study did not experience problems. The problems faced by subjects in the subject matter are caused by learning styles that are different from other students. Visual learning styles make DHH students limited to audio information. Teacher skills to optimize visual information will improve the understanding of the magnetic field lesson. The focus and concentration of DHH students also help students learn.

Findings after teaching magnetic field lesson, namely:

a. In the initial teaching, regular teachers taught by the lecture method which made it difficult for DHH students to focus and only understand the part they could see from the teacher's lips.
b. Experimental demonstration makes the teacher reduce abstract information and dominantly convey more concrete material.
c. Experimental demonstrations activate students with direct practice as an experience of learning magnetic field lessons.
d. Strengthening by special teachers with sign language strengthens the understanding of DHH students.
e. The results showed that in addition to IQ levels, concrete visual information, direct learning experience, and teacher collaboration increased understanding of DHH students.

Table 1. Questions About Understanding Magnetic Field Lesson

No	**Question**	**Student**			
		A		**B**	
		Wo	**W**	**Wo**	**W**

1	Do you know about the nature of magnetism?	2	5	1	3
2	What is the number of magnetic poles?	2	4	1	3
3	What is meant by a magnetic field?	1	3	1	2
4	Where is the direction of the magnetic force?	1	4	1	2
5	Mention the nature of the magnetic force	1	3	1	2

* Note: Comparison of students in understanding magnetic field, Wo = Without experimental, and W = Experimental

3.3 Seating Position Factors in Class on The Success of Teaching

The next observation the authors saw the influence of the seating position. The seating position and classroom size influence learning [28]. According to Lestari et al, the seating position influences the cognitive of the child [29]. To find out the factors of the DHH student's seating position on the teaching of a magnetic field lesson, the research places students in three positions. Krissadi et al.'s research show the relationship between the location of seating and learning outcomes [30].

In the position I, DHH students are in the back seat. Second place, DHH students are placed in the middle. Third place, students are positioned in the front position. Figure 4 shows the relationship of understanding the DHH students' magnetic field lesson with a seating position.

When positioned behind, DHH students did not understand the teaching of the magnetic field lesson. The seating position determines the level of participation in learning [31]. Student A has an understanding level score 2. The level of understanding of the magnetic field lesson of student A at a low level. Student B when in the back position scores 1. Understanding the magnetic field lesson of student, A is very poor.

In position II, DHH students are in the middle. Student A scores 3. That is, student A's understanding of the magnetic field lesson is at a moderate level. Student B, when positioned in the middle, gets a score of 1. This means that the understanding of student B's magnetic field lesson is still very low.

In position III, DHH students are in front. Understanding of students, a has increased with a score of 4. This means that the understanding of student A increases at a high level. Student B also experiences an increase with a score of 3. This means understanding student’s B at a moderate level.

The researcher looked at the placement of DHH students' seating positions affecting the understanding of the magnetic field lesson. In the back position, DHH students gain a low level of understanding. DHH students find it difficult to receive stimulus from the teacher due to long distances. the visual stimulus of DHH students is blocked by other students. DHH students are visual learners. The middle position makes DHH students a little better in visual reception. Closer distances allow DHH students to better understand the magnetic field lesson. The teacher's writing and lips are more clearly seen by DHH students. The possibility of DHH students being obstructed their views diminishes. The front position is very helpful for DHH students to understand the magnetic field lesson. A seating position can be used to predict interaction patterns [32]. The interaction of DHH teachers and students without obstacles. DHH students can see the magnetic field lesson stimulus very clearly. The main stimulus for DHH students is a visual stimulus. The second condition of DHH students showed a significant increase based on the seating position. The choice of seating significantly affects student performance.

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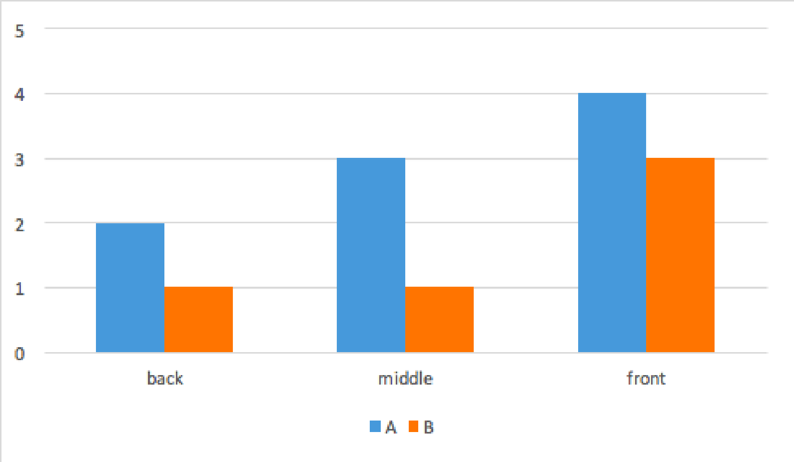

Fig. 4. The Level of Understanding DHH Students Based On Seating Position

V. CONCLUSION

The results of this study show that DHH students can mastered in magnetic field material. Collaborative teaching between regular teachers and special teachers makes it easy for DHH students to understand the material. Regular teachers deliver material using the experimental method while the special teachers repeat the material with sign language and clear verbal language. The experimental method makes the magnetic field material more concrete. The placement of DHH student seating positions becomes the teacher's strategy to make it easier to receive information. Sign language and the verbal language of special teachers are well received by DHH students. The visual abilities of DHH students must be optimized because auditory barriers to receiving audio information. Research in the science field for students with special needs is still small, even though the number of students is increasing. The author hopes that this research can trigger a lot of scientific research that is intended for students with special needs, especially DHH. The other scientific research that appears is expected also not only in the learning process but also in assistive technology for students with special needs.

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