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DEVELOPING AUDIO TACTILE FOR VISUALLY IMPAIRED STUDENTS

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ABSTRACT

The aim of this study is to develop teaching materials based on Audio Tactile which is valid, practical, and effective to improve learning motivation and achievement of visually impaired students. This study was a research and development (R&D). The data collection techniques in this research were observation, interview, documentation, and tests. This research used a qualitative approach as a data analysis technique. The conclusions of this study were the product developed as a set of audio tactile teaching materials which consisted of learning audio sources and tactile media. These audio teaching materials were supported by several tactile media such as planes, puzzle, *geoboard*, tactile rules, and tactile protactor. The Audio Tactile teaching materials can improve learning motivation of visually impairment students. The increase of learning motivation was indicated by high student's will to study, student's high perservance, student's enjoyment, and curiosity. The Audio tactile teaching materials gave great positive impacts on learning achievements. This is shown by the increasing score of posttest compared to the score of pretest.

Key Words: Planes, visually impaired students, audio tactile, teaching materials**.**

INTRODUCTION

A nation is not permitted to differentiate each citizen in education accomplishment. In indonesia, it is clearly and visually stated in the 1945 constitution article 31 verse 1. It expressed that every citizen has the same chance to experience an education. UUD 45 backed the law of national education system no. 20 years 2003 part 11th article 32 mention that, special education is education for learners who have the level of difficulty in following the learning process because of physical abnormalities, emotional, mental, social, and/or having the potential of intelligence and talent privilege. Ideally, all disabled must have access to learning and related institutions that are capable of providing facilities memadahi to support learning process. Academic facilities in schools are having largest infleunce against math achievement for students who are visually impaired student (Giesen, Cavenaugh, & McDonnall, 2012).

The visually impaired is one type of disabilities who have limitation on vision. The visually impaired divided into two big categories namely low vision and blind. The categorization of it is used as a basis of the handling in learning process. Low vision is visual impairment still has the rest of sight and can identify visual information with the tools. While blind is the one who are notable to access visual information at all (Roe & Wesbter, 2003). The psychological of the visually impaired person is a excessive worry because of limited ability to control environmental conditions. It makes visually impaired person often exaggerated in fear. The impact of it is a lack of confidence, the suspect remains in the environment, not independent, petulant, lone, passive, easily discouraged , and difficult to adjust (Hadi, 2005).

Based on the data from the Central Bureau of Statistics (BPS), the number of visual impairment in indonesia reached about 3.5 million people or about 1.5 percent of a population (Fitriyah, 2013).Thus, there is no reason

for the Government not to meet the needs of visually impaired students' education. Through a process of education, visually impaired should be maximized to be a productive people. The school does not solely develop cognitive potentials but also provides intercommunication. Integrated education can develop the visually impaired students' capabilities of the communication. Therefore, they are able to get along well with their neighbors (Bowen, 2010).

One of the provisions given in the school is the science of mathematics. Mathematics equips students to logic, confidence in solving problems, and draw conclusions in order to solve the daily problem (Aisyah & Retnawati, 2014). The ability of the trained students were unnoticed by a mathematical problem solving process. At the junior high school level, the first student are taught to understand geometry phenomena.

Geometry is a material that combines the concept of geometry with the development of a visual perception (Barmby, et. al., 2009). This material is considered as important thing to be taught because it may raise people's ability to solve some daily problems. Hoffer (Yee & Hoe, 2009) said learning geometry can develop various abilities such as *visual skill, verbal skill, drawing skill, logical skill, and applied skill.* However, this material should be mastered by student, not only in mathematics lesson but also in daily life.

In general, geometry taught with various examples of visual and illustration (Rouzier, 2004). Vision limitation of visually impaired makes them can't learn to geometry as easy as other students who can access visuals data. The condition maked geometry as a serious problem in the study of visually impaired. Geometry demands the teacher to learn perception. Limitation of visually impaired demands the teacher must have maximizing the senses of touch. The sense of touch is used to identify the geometric shapes. It is very good to increase the understanding of the visually impaired student (Salisbury, 2008).That effort can be done by the provision of props. Mani, et. al (2005) said thatshould geometry props having a well-proportioned, strong and secure. While Suherman, et. al. (2003) said props should be durable, interesting, a measure proportionate, multi-function, and can be presenting the concept.

In students' learning, a source of learning is a special problem (Retnawati, Prajitno& Hermanto, 2015). The limitation of a source of learning and props was a serious problem in the education process of visually impaired student. This condition is not ideal in the process of learning geometry that require contextual and practices example. The visually impaired students are taught to memorize all the formula a broad itinerant or volume as to be applied. Therefore, the learning process was meaningless. Consequently, there were students who were less motivated to study harder. Preliminary observations data showed that the blind students did not have a strong-will in learning mathematics. Students are too lazy and lack of initiativesin learning mathematics. The data is strengthened by students' passive and easily discouraged conduct when the learning is taken. These facts showed that the there is a motivation problem of students in learning about mathematics.

Motivation is one of the vital things that affect the learning process. Motivation is an impetus that leads to a goal. Indication of motivation is the willingness to learn, effective time management, diligent, persistent, glad and curiosity. Therefore, the motivation will exert influence on each learning outcome (Gottfried & Hudley, 2008; Santrock, 2008; Brophy, 2010). Students' learning motivation are originated from subjective experience students, especially that is connected to their willingness to engage in the activities of learning and the reason they to do so (Brophy, 2010). In a task, especially a relatively complicated one, students must maintain their motivation to achieve a good result (Sullo, 2009). Teachers can see the motivation of his behavior when students receive the complicated problems (DeCaro, DeCaro & Rittle-Johnson, 2015). Hence, motivation of learning is an important aspect which affects the purpose of learningachievement.

Lack of motivation is directly proportional to the accomplishment of student learning. In preliminary observations, it was found the fact that the majority of the visually impaired students were difficult to learn mathematics. It seemed that they did not often reachedminimum standards in doing the test.

Limitation of learning materials is predicted as one of the problems for low motivation and student learning achievements. The visually impaired student have difficulties in documenting integrated mental picture.

Tactual exploration make the visually impaired studentseasy to coordinate a knowledge in their mind (Swarup & Bhan, 2006). In an effort to facilitate the visually impaired students, it maximize the sense of hearing and the feeler.Holmes, et.al in (Hersh & Johnson, 2008) said The efficiency of tactile media can be maximized by adding information audio. The addition of audio makes the media as detail information. In addition, the visually impaired students will be more interested and relatively energetic and effective in terms of accessing the information. The merging of tactile and audio will be comfortable thing for learning.

Basically, all can be encouraged to make availability of facility of the visually impaired student to be comfortable in learning. A lot of visual information could be converted into non-visual information (Mani, at. al., 2005). As the conclusion, the visually impaired have to maximize the senses of good working example haptic (touch) and hearing (Hersh & Johnson, 2008). For a variety of information, visual images can be packaged into a concrete object that is a mathematic problem or writing that can be converted into a braille or audio information.

According to Whittingham (2013), audiobook can be accessed by the visually impaired student well. Even the existence of audiobook can increase the passion of reading. Basically, almost all information can be given to be accessedby visually impaired. Audiobook are the result of technologies that could be to exert an influence on motivation and achievement. Conclusions were based upon advantage of the existence of information technology that facilitate the students to learn independently, whenever and wherever (Lin, Chen & Nien, 2014).

Involving the hearing and touch can gives them flexibility to use material things contextually. Explain planes in the concrete lesson would ease the students to understand (Retnawati, Prajitno & Hermanto, 2015). The material that taught contextually can give a meaning of this material. The meaning of material will save the subject matter in long-term memory (Kyriacou, 2010). One of mathematics learning strategy is to include information in long-term memory. New ideas and experience is transferred from the short-term memory to the long-termmemory where it is kept and use for later. The process will be supported by motivation, intentions and strong emotion (Kennedy, Tipps, & Johnson, 2008).

Hence, in this research developed teaching materials based on audio tactile so it can be accessed by the visually impaired students. It intends that visually impaired students can learn geometry (planes) in an inconvenient way. All the visual information that are commonly used to the learning process will be converted into audio-based and tactile-based. The expectation is that motivation and learning achievements of visually impaired students will improve. Thus, the purpose of this research is to develop planes teaching materials with audio and tactual-based and to know the influence of motivation and student learning achievements.

METHOD

The research is a research and development (R&D) with the following steps: preliminary observation, planning and design, initial product development, the trial, the revision of the trial results, and the final product. The study was conducted between December 2014 to May 2015 in six placesnamely: the researcher's home, Utak's home recording, Dria Manunggal, SMPN 2 Sewon Bantul Yogyakarta, Indonesia, and MTs Yaketunis Yogyakarta Indonesia.The process of research involved four students from two schools, one student from SMPN 2 Sewon and three students from MTs Yaketunis. All of them were 7th grade students. They were Ilsa, Anka, Samu, and Sugeng (pseudonym). Data collection techniques in this research were observation, in-depth interview, documentation, and test. Thus, the instrument of data collection in this research were guidelines for observation, guidelines for documentation, sheets of validation, and the evaluation of learning achievements and tests.

The quality of teaching materials was based on three basic aspects, which each of those were feasibility, practicality, and effectiveness (Van den Akker, 1999). Plomp (2007) stated that the feasibility of referring to the level of intervention of a design based on knowledge of state-of-the art (content validity) and suitability teaching materials conformity with the validity of theory (constructvalidity). Practicality was seen in terms of

the use of assessed by the experts and practitioners. The focus of the judgement was the relevance of teaching materials within its normal condition and the fact through trial and error (Van den Akker, 1999). Effectiveness is the relationship between the plan and achievements (Nieveen, 2007).

Content validation was implemented through the expert judgement. The experts involved in the validation process are visually impaired education expert, mathematics education expert, and media of mathematics education. To know it further , data will be analyzed using an index of the validity of grain-proposed Aiken (Retnawati, 2014).

$$V = \frac{\Sigma s}{n\,(c-1)}$$

Where ''V'' is the validity of grains index; ''s'' is the score that determined each rater that reduced the score the lowest in the category of used (s = r – lo, with r =the score categories rater choice andlowest score in the scoring category); n is symbol of total rater; and c is the number of categories that may be selected as a rater.

Practicality, the effectiveness,and improve of the learning motivation will be analyzed based on data interview, observation and documentation by using various qualitative techniques. Data triangulation was implemented to keep thequality of the data. A variety of the data gathered will be analyzed with a qualitative approach developed by Miles and Huberman. Qualitative research analysis was implemented since pre-research until the research step was finished. Miles & Huberman (1994) said that the steps in qualitative data analysis are data collection, data reduction, display, and conclusion. The process was started from data recapitulation and reduction of the data, included the simplification of data to verify the relevant data. The data reduction were classified in accordance with a design analysis that has been designed. Then, all of them will be displayed. Any reduction of data that has been classified was verified by various fact at the field , included the results of test results validation and achievements student learning. Then, data was verified andsome conclusions were taken.

An analysis technique applied n-gain. The formulation to judge the improvement of learning achievement of pretest posttest was as follows:

$$\text{N-Gain} = \frac{posttest\ value\ -\ pretest\ value}{Ideal\ maximum\ value - Pretest\ value}$$

Table 1:Criteria for Improvementof Learning Achievement

Interval	Criteria
N-Gain > 0,7	High
0,3 < N-Gain < 0,7	Middle
N-Gain < 0,3	Low

FINDINGS

The result of this research and development is a product development of audio tactile teaching materials which consists of a source of learning and various audio tactile props. The development product is based on of various problems that collected from interview and observation. The data is obtained which later is examined in greater depth by using the various relevant theories. The main problem will be resolved through the product development is learning achievement and low motivation, which is not optimal.The researcher found that fundamental problem here is lack of ability in operatingthe numbers, ability to read a symbol of mathematics in braille, psychologically unstable students, learning independency, diversecognitive ability, lack of learning materials, lack of props, the context learning source or process that still could not meet the context for visually impaired, and the learning process that tends to be one-directed. This problem is expected to be solved. Therefore, visually impaired students can develop their verbal skill, drawing skill, logical skill, and other applied skill as the result of geometry teaching.

An audio learning source is the conversion from visual information to audio information. But to give comfort to the visually impaired in learning, the audio learning source based on visually impaired students' character and experience need to be developed. Various kinds of illustration and a model are designed to consider various aspects that could support a visually impaired students to learn.

The preparation of material is adapted to the curriculum that is enacted in the schools. MTs Yaketunis Yogyakarta Indonesia and SMPN 2 Sewon Bantul Yogyakarta Indonesia are the school with similar concept, namely inclusion school. Thus, they use same curriculum. The primary competence must be fulfilled in audio teaching materials is identifyingthe properties of planes and using it to determine the circumference and area, estimate, and count up the surface area that irregularly shaped by applying the principles of geometry, and finish the real problems related to the application of the properties of rectangular, square, trapezoid, parallelogram, rhombus, and kites.

Mathematics is abstract science that is hard to be learned (Retnawati, Prajitno & Hermanto, 2015). Hence, sequence of material based on a mathematical concept of which were adapted to learning experience and the ability of the visually impaired. The second meeting, teacher explained about quadrilateral. The quadrilateral properties explained according to the concept of quadrilateral, ranging from parallelogram, rectangular, square, rhombus, trapezium; then the kite. Order of following based on the definition of each is built so that it can be analyzed from general to specific one in order to be easier to be understood.

However, more detail the circumference and area,they are presented in a different sequence. It is started with explanation about circumference and area of square. The reason of the sequence is the square more famous than other. This makes the student comfort and easy to learn. Then, a learning that is more difficult to be understood is rectangular. Then, the more difficult to be learned are trapezium and parallelogram. They are more difficult than square and rectangular because the student must understand about concept of high. The last materials are rhombus and kites. To understand both, students must understand diagonal concept.

Next, student learns about triangle. The lesson begins with the introduction of the triangle properties and continued with circumference and area triangle. After students understand the material of a triangle, student begins to learn complex planes. Complex planes intended in this context is a structure formed by a variety of planes that have been studied.

After the materials are composed, the next step is the study of some examples of contextual and illustration adapted to the experience of the visually impaired cognition. The selection of example is contextual and complexity typical illustration. Noticed problem and experience in the process of analysis is undertaken by the visually impaired have significant differences with other students. Hence, the researcher needs to imagine living like the visually impaired or doing in-depth interview directly with the visually impaired.

A variety of digital book that can be accessed by the visually impaired have some contextual and illustrations examples from insight cognition perspective within general students such a bridge, unique building, screen on a ship, and variety of objects that do not exist in the set of visually impaired experience. Through interviews and a variety of the investigation were selected some examples of contextual simple that can be imagined by the visually impaired easily such a paper craft, tiles, kramik, and food.

After various examples of well-planned contextual and illustration, then did interesting studied on packaging is important. An audio teaching material will be interesting if the charge of the material presented with various styles. In general, it is delivered with narrative.But, some illustration delivered with packaging story. It was expected student more interested so feel contextual illustration exist in their environment.

The illustration is seen in the form of drama to attract the attention of visually impaired students and provide students'motivation to learn. The crucial point is when students know the benefits of learn through various

problems contextual contained in conversation drama. Therefore, there are illustration in the form of drama at the beginning of each chapter and some other part.

After arranged, next is the validation process that involves education expert. The process of validation produces a variety of the revision of the format and matter. The format revision is additional duration of information in the manuscript. The addition of a column of the duration is intended to make good learning plan to make it accurate in accordance with the allocation of the time allotted.The second revision is the additional information on various an emblem of mathematics, for example: ‘’square with long side of the 10 cm (read: ten centimeters)’’. Therefore, it is done to anticipate if the narator's background study is not from mathematics education. The third revision is props symbols on the manuscript that combine audio and visual aids. The solution of the problem for audio files uses a symbol of "A" then is followed by a series of props and audio files uses symbol "M" then is followed by a series of props.

The first revision, is about the story that involves only male role. To be more interesting,it can represent all students and the changes on the role that involves men and women. The second revision is formula of a triangular area that known as the third side. At first, the root of the results of multiplied by (s-a) multiplied by (s-b) multiplied by (s-c) is narrated. The repeatation of "multiplied by" can disrupt the visually impaired to understand the information.Therefore, narrative is converted into root from the multiplication of *S, (S-a), (S-b) and (S-c)*.The third revision is instructing the students to concern with the letter L. The fist instruction is *"... building school friends L-shaped trying to find the amount is between tiles if ..."*.There are things that are not seen by visually impaired L-shaped. Visually impaired don't know alphabet letter, visually impaired use braille. Thus, the instruction is revised into *"...building school friends L-shaped alphabet (combined two rectangulars) try to find ..."*.

After the revision, the audio is ready to be made into a recording. The production process is conducted at Utak home recording in Karangwaru Lor TRII no .2309 Yogyakarta. In the production of processing audio file, researcheris assisted by Muhammad Yudi Eko Nugroho as professional sound engineer. The process of recording is repeatedly made to get a clear sound. The process of recording can be finished in just 12 hours with being divided into two days. After the recording finished, we found a noise sound. It was edited with software logic pro in order to clear up so that it can to be listened nicely.

The audio file is validated by expert. From the results of the validation, audio file had is declared good. But audio file need the addition of the tone of opening and closing. Then, researcherinvolves Rendi Indrayanto as jingle composer to make tone and fill it in teaching materials audio. The tone of opening and cover is varied in accordance with the scope of the materials within them. The tone of opening of teaching materials made with the duration of 25 seconds with the concept of the spirit in order to attract and evoke the spirit of students in learning. Meanwhile, the tone of a cover of teaching materials made with the duration of 19 seconds with the concept of the tone is little dims, too. Meanwhile, for the bulkhead of any sub material, short and simple tone with the duration of 6 seconds is made.

Other product development is tactual media which consists of geoboard, tactile ruler, tactile protactor, tactile picture, planes model and puzzle. The products are chosen based on various kinds of considerations that refer to the needs of teachers in explaining the material. The process begins with the assessing any matter which are arranged in a source of learning audio one by one and then concludes several parts that need the props. The concept of the media is proportional, strong, sturdy, safe, and it can present the concept of mathematics with good and simple way. The various developments of the media are as follows.

The acrylics are materials suitable for making geoboard. Based on the conclusions, the acrylics are materials that are delicate, not sharp, light, and has affordable price. Then, researcher determines the other material to make spines on geoboard. Another material such as bamboo sticks with a measure the diameter of 3 mm is chosen, too.The reason of the election of the material is much in the market, not sharp and it can be affixed with acrylic. Lenght of thorns is designed with the size of 3 mm overhanging. To set the sticks we use glue alteco/g.

Through various discussion of the process, validation, and observation to a variety of a shortage must be improved of the geoboard. The various of shortage is the distance of 1 cm, which is too crowded to the students' finger that the fingers of the visually impaired may not enter in to the sidelines of thorns to explore the form of. The other, geoboard is relatively expensive, one geoboard needs around IDR 30.000,00 (about 2.5 US$).

Therefore,revision needed based on validation result. The first media is spines. The distance between the spines is stretched to 1.5 cm. The impact is that the explanation and instruction in a source of learning which was originally "1 cm long",would be changed into "assumed 1 cm long". The other revisions of other materials were originally acrylic and bamboo sticks would be changed into plywood and nails. The replacement of the materials makes geoboard be cheaper, simple, and ease of use.

The second media is a tactile ruler. Tactile prop is used to give facilities to t visuahelly impaired students doing measurement of length. The concept of a tactile ruler is transforming vision information scale into tactile scale information. Pointer scale packed in arising and information scale in braille. The use of the scale of arising gives limitations on the level of ruler thoroughness. The proportional size and a tactile symbol isdesigned into a ruler that has 5 mm thickness. Some other materials that were chosen in the manufacture of a ruler tactile are manila paper, making pointer a scale with thread and a information scale that printed with reglet.

Meanwhile, in the validation process, a ruler tactile is invalid to be tested. Through discussions with validator, it could concluded that tactile ruler have many deficiencies such as the line that is not straight, using glue that makes the texture broken, scale pointer is not clear because it is not at the edge of a ruler, manila paper is relatively delicate, followeed by vulnerable and easy damaged torn.

Revision was done based on product weakness from the validation process. Revision performed on the improvement of the material which is manila paper become ivory paper. The advantages of using ivory paper is thatit is a reuse paper from the offset. Most of the invitation letters are made of it. The impact is that the price is cheap. Another completed revision is making the sign of the scale of which are using thread, is replaced by printing texture with rader. Rader that is used as a printer give an advantage. The scale became stronger, cleared, and more economical.

A first revision tactile ruler entered in the process of continued validation and declared valid to be trial and error. The various components such as a line and the point have been easy to read. The tactile ruler has already noted as a strong madia, easy to be used by the visually impaired, not dangerous, accurate, simple, and it can be made easily.

The third tactile media is a tactile protractor. A tactile protractor is developed in order to facilitate students in making measurements size of angle. The concept of a tactile protractor is same with a tactile ruler, which is change the visual scale into tactile scale. Pointer scale is packed in arising and the information in braille. The use of the scale of arising can overcome the limitations on the level of thoroughness a protractor. Through consideration of proportional size, then the design of a protactor with the level of thoroughness $5^{\circ}$is made.The material chosen in making a protractor taktual is manila paper. Meanwhile, the thread such as materials to make the sign of a scale and the information of a scale is printed with reglet.

Validator assessed the tactile protractor and it declaredasinvalid to be trialled out. From various discussions, it is concluded that the tactile protractor are still having a variety of a weakness. The weakness is that using threads does not produce a straight line, the line not resting at one point, manila paper is not strong enough to hold the thread, then it damaged. Besides that, the use of glue in a gluing the thread make the quality of paper decreased (become matted and easily torn), braille should not be written sloping like the alphabet scale and complete information should be written includingthe sign of numbers and the real worth (originally, in the tactile protractor has simplification so that 60 written 6; 100 written 10; and so on).

Revision was made to repair any weakness of the product. Various improvements are the replacement of material with a straight line with the printing by rader and scale written in accordance with Brailleinternational standard (horizontal). After revision, the products were back into the validation process. The tactile protractor still has invalid to trial and error. Researcher found two deficients in a tactile protractor such as paper isn't strong and information scale not comfortable to read. Revision is done in terms of scale writing and materials. Ivory paper chosen as a substitute for manila paper because it considered to be more powerful and information scale is writtenwith the span of 30°. The new tactile protractor was declared valid to trial and error by judgement.

The last tactile media is props that ease visually impaired students to learn planes. First props is tactile images. It changes the generalimages based on tactual information that converted into an images. The images made of[paper ivory by using rader to draw and reglet to write a description. The tactile images were declared valid by expert. Next media is planes model. The same model with a commonly used in the process of students in general. But the production is considering all criteria for the visually impaired. Therefore,paperboard selected as base materials. The model is not harmful, simple, and economical. In the validation process, the planes model is declared valid by experts. The last kind of the tactile media is puzzle. The concept of the puzzle is to explain a variety of complicated concept that is captured by the senses of touch such as high on parallelogram, diagonal on a kite or the number of large all the angles in triangles. The puzzle is made based on concept that exists in general student. Meanwhile, the materials of puzzle are cardboards.

Validation of puzzle result the puzzle is declared invalid so that it needs to be revised. Experts said that the puzzle is inaccesible for explorated by visually impaired. The visually impaired students could peotentially get confused because there is no marker one part with the other part. Therefore, the revision is need to be done. The revision is done by adopting the concept of a visually impaired chessboard. Every part is designed based on itsdifferent heights for some parts in puzzle so that visually impaired students can easily to access. Visually impaired could explore any part through the edges of the part of having different heights. The experts declared the puzzle is valid to trial and error.

After all products valid and all developing products are ready to be trialled. The process of the trial is relatively going smoothly. The trial process was conducted to know the quality of product development. In the trial process, researcher observedthe achivement of development product, the condition of the students' motivation, and student learning achievements. There are several points which showed that some parts of the development products need to be revised. Various problems were obtained in the first meeting. There were some students caught several times read the description the scale on the tactile protractor. Meanwhile, from five to eight meetings, the students were wasted too long time to explore a puzzle, and at the next meeting, the students had difficulty in drawing a triangle on geoboard. The various problems become a datas source to develop the product.

During the trial, students tend to show the good learning motivation if compared with the pre-research motivation data. The data of pre-research observation showed any problems of students' motivation learning. In the learning process, it was often to be seen that they were not fullyfocused, less serious, passive, feel under pressure, and just write what the teacher explain. The efforts on any material difficulties were not seen.

Motivation problem that is often derived from the assumption is that mathematics is a difficult lesson and less favored. Even students will not sure about their ability in studying mathematics. Schunk (2012) said students will continue the learning process while they had confidence. Meanwhile, Santrock (2008) supported thatmotivation give direction to someone in doing something. Unconfidence would be damage the people's direction in their learning purpose. Students have good motivation when there is an interesting and fun way of earning (Brophy, 2010). Therefore, motivation problems of visually impaired students would be proven with fun and contextual audio tactile teaching materials based on necessity.

When product is trialled, it is showed that the audio tactile teaching materials provide a positive effect on students' learning motivation. Students become more focussed in the lesson. Students feel helpful during the

learning process by the use of various models and a measuring instrument. Measure the length and angle make the visually impaired students active and give meaning to the subjetc which is learned. Learning by using the model makes it easy for the visually impaired students to connect the materials with their environment. The impact of it made the learning so meaningful. Brophy (2010) saidthe meaningful lesson and to connect with environment can improve students intrinsic motivation.

Audio tactile teaching materials made visually impaired students learning flexibly and independently. Audio files can be accessed easily through cellular phone or computer. During this one of the problems that made learning difficulties of the visually impaired students is the lack of teaching materials that could be accessed. The existence learning source that can be accessed easily made students are encouraged to learn. Anka said that audio teaching materials made him easy in learning. Excellence in audio material can be heard casually. It indicates that student learning times increased along with the audio materials that easily accessible.

A tactile ruler and tactile protractor give confidence in students. Before this, the visually impaired students were only passive when others students measure the length and angles. The process of learning using model makes the students become more active. Students tamper with a model to complete their understandings. Practice makes the process of learning enjoyable. A not tense learning make students happy and comfortable. When trialling the products, students often secreting a smile or launching a joke. But the teacher will remain vigilant with the activity of students in order to not wasting a lot of time and students just playing around. Teachers organizing kept the class relax and running on schedule.

Audio tactile teaching materials direct students to discuss with friends. According to the observation data, students discuss with friends seatmate. By the time students practice the process, they discussed with friends about how the results or how to practice. However, students' critical thinking are not significantly increased yet. Students still have not been able to ask and actively involved. Students tend to follow the instructions without clarifying the variety of information provided.

The last process of trial and error was a posttest. It was implemented in order to know the students' achievement. The value of the posttest will be compared with the value of the pretest to conclude improvement of learning achievements. As for the pretest and posttest, the data is as follows.

Table 2: Data of pretest and posttest

Siswa	*Pretest*	*Posttest*	N-Gain	status
Ilsa	1,25	2,92	0,19	incomplete
Samu	3,75	5,83	0,33	incomplete
Anka	2,50	7,08	0,61	Complete
Sugeng	5,00	8,33	0,67	Complete

Study of using N-Gain indicates that all students achievement is improved. Ilsa has improvement index 0,19 (low category). While three other students has index of N-Gain 0.33; 0,61; and 0.67. All three students that has index above 0.3 showed improved learning achievement include middle categories. If we studied minimum requirements or completeness criteria, only Anka and Sugeng can reach it with a value of 7.08 and 8.33. Ilsa (2.92) and Samu (5.83) were still not reached minimum criteria. The minimum criteria in MTs Yaketunis, Yogyakarta, Indonesia is 6.50 and in SMPN 2 Sewon, Bantul, Yogyakarta, Indonesia is 7.00.However, all students have certain of significant improvement. At first, students could not measure the length and size of angle. However, after the process, all students are able measure it.

After the trial and error obtained, data set can be used as a reference for the improvement of the product. A problem on the first day is the mistake of students in reading the information in the scales of a tactile protractor, which is caused by the collision between the lines scale pointer and information scales. The problem was anticipated by writing a scale in separate paper and attaching on the true location. This solution makes the lineand information scales become clearer.

DISCUSSION

Problems in the fifth to eighth meeting are on the visually impaired students spend much time to find a puzzle places. It was anticipated by combining two places puzzle into one back and front puzzle. Such as combination can make students easy using that because of its conciseness. Geoboard is unable to facilitate students to study triangle properties. To anticipate its weaknesses, the learners are assisted by a tactile protractor and a tactile ruler. It would give the convenience to the visually impaired students to learn the properties of a triangle. Other problems are that not all inclusion school teachershave competence in reading braille. The information on the tactile protractor and tactile ruler based on braille can make it difficult for teachers. Thus, the new product is equipped with scale based on visual information (alphabet scale information). The last problem that will be addressed is the difficulty of students to understand the complex planes. Learn to use puzzle is not enough to make students understand. The reason is because it was done by media aid to provide understanding on students. The floor was selected as the media aid to explain it. The reason of choosing the floor is because of a visually impaired students are familiar with the floor and it can be easily palpable.

The quality of the final product is viewed based on its feasibility, practicality and effectiveness. Audio tactile teaching materials iscurriculum 2013-based design and it declared valid by visually impaired educator expert, mathematics education media expert, and math education expert. The feasibility of audio tactile teaching materials is based on theory. Mathematics teaching materials should be good in pedagogy, physical, and blindness. Specifically, assessment of teaching materials are separated into two parts, which are instrument assessment quality of audio and instrument assessment quality oftactile. A source of learning audio has been declared valid by expert if it can meet the standard.Smaldino, et. al. (2005, p.276)said that the audio tactile teaching materials should meet thegoal of the curriculum, accurate,up to date, clear,has concise language, motivating, and interesting. It must also meetthe learner participation, technical quality, effectiveness rating, bias-free, can guide the user and can be documentated, appropriate and clear. Meanwhile, the audio tactile teaching materials must fulfill standards of quality teaching materials, which are durable, interesting, simple, easy to use, proportional, and can present the concept of mathematics flawlessly (Mani, et. al, 2005; Suherman, et. al, 2003).

Audio tactile teaching materials meet the standard practice. All of learning plan are successfully carried out. Visually impaired students can follow the learning proccess well. Teachers said that the using of an instrument can make students in learning more independently, know the concept more, and learning time can be efficient. Thus, the productcan besaid to bea practical product.

Effectiveness is the relation between the plan and achievement. In terms of student learning achievements, all students is improved. Reviewed in terms of learning activities, using audio tactile teaching material can make learning proccess more conductive. The visually impaired students really enjoy it when they do some practices and explore various media. The visually impaired students that were relatively passive before, became actively participate in the process of learning. Students give well-response in the existence of a audio tactile teaching materials. The goals are set by indicating the effectiveness of students improvement.

In the process of trial, the data is obtained that all students are able to measure degree of angle with a tactile protractor and measuring lengths with a tactile ruler. This competence was not possessed by the students using audio tactile teaching materials. Thus, it can be concluded that audio tactile teaching materials are effective to improve the skill.

CONCLUSION

Development products are a source of audio tactile teaching materials. It consist of audio learning resources and tactile media that are valid, practical, and effective. Tactile media consists of a model, puzzle, geoboard, tactile ruler, and tactile protractor. Audio tactile for each materials can improve students'a motivation in learning. The motivation improvement is measured in various aspects of learning which consists of utilization of time learning, perseverance, tenacity, enthusiasm, and curiosity.Audio Tactile teaching materials give great

positive impacts on learning achievements. This is shown by the increasing score of posttest, compared to the score of pretest. According to an index of the increase, three students with index 0.33, 0.61, and 0.67 are included in the middle category. The other student gets index 0.19 and is included in low category.If it assessed from minimum requirements, Anka and Sugeng can reach it with 7.08 and 8.33 point. While Ilsa and Samu can't reach it with 2.92 and 5.83.

From a variety of experience acquired in the process of research, researcher provides a variety of suggestions to enlarge the use of product. The suggestions are research is needed at the beginning of to see the basic ability of students such as supporting the process of learning. An analysis of the allocation of time needed should be done. Besides that, in accordance with the ability of students, teachers need to have broad insight about the experience of the visually impaired in order to give valuable illustration. Then, teachers must make props independently, and teachers should make a variety of innovation in other props that can help the learning process.

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