



## IMPROVING THE VISUAL-SPATIAL INTELLIGENCE AND RESULTS OF LEARNING OF JUNIOR HIGH SCHOOL STUDENTS' WITH MULTIPLE INTELLIGENCES-BASED STUDENTS WORKSHEET LEARNING ON LENS MATERIALS

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### ABSTRACT

This research is done for the development of students' worksheet (LKPD) about multiple intelligences-based lens materials for improving the students' visual-spatial intelligence and results of learning of SMP N 2 Banda Aceh. This research uses a quasi-experimental design with pretest and posttest group. The sampling was done by purposive sampling technique. The data collection was conducted with pretest and posttest for visual-spatial intelligence and learning outcomes. The questionnaire was used to determine the response of students after using students' worksheet based on multiple bits of intelligence. The results of normality and homogeneity test show that the data was homogen and normally distributed. Therefore, the average difference test against the N-gain visual-spatial intelligence and learning outcomes between the two classes used t test and obtained a significant difference in learning outcomes between the two classes. The average score of the N-gain visual-spatial intelligence and learning outcomes for both classes was in the middle category, where the experimental class is 0.65 (65%), while for class gained control is 0.46 (46%). Learners gave a positive response to the use of multiple intelligences-based students' worksheet dealing with lens materials that can enhance their visual-spatial intelligence and learning outcomes.

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**Keywords:** students' worksheet; multiple bits of intelligence; visual-spatial; learning outcomes

### INTRODUCTION

Natural science education as one of the lessons that are usually learned by mathematical approach tends to be worried by the students. There are two intelligence standards used in the school for assessing students. They are linguistic intelligence and mathematic logics. In the learning process, teachers sometimes forget the eight kinds of intelligence so called multiple bits of intelligence (MI). According to Delgoshaei & Delavari (2012), inside a child's self, there is intelligence which can be more dominant than other intelligence. So, the child can easily understand the materials if the learning and teaching are done

by considering the intelligence. Many students' failures in understanding the materials from the teacher caused by the teachers' inappropriate teaching style with the students' learning style. A person's intelligence inclination reflects his/her learning style. This makes the students unable to give a positive response in natural science teaching and give effects to the lowness of learning outcomes (Wibowo & Suhandi, 2013).

According to the studies done by some researchers, teachers have tried best to teach all natural science materials, but there are some things missed, for example in visualizing the abstract of natural science concepts to the students. The available student's worksheet cannot help them in understanding those concepts because it only contains fewer materials and tasks. This kind of

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worksheet does not help students much in their intelligence. In line with it, after this study is done, some images are obtained that the students in SMP N 2 Banda Aceh have various kinds of intelligence. This finding can be a foundation of teaching media development that can improve the students' learning style and their intelligence. Armstrong (2004) asserted that students in every class have different skills (intelligence, talent, understanding speed). Teachers should pay attention at the students' intelligence besides paying attention to the materials.

Generally, students find themselves in a problem in learning natural science, especially in lens materials. Their difficulty is in differentiating kinds of lens and kinds of lens' shadows. Besides, students felt difficult in understanding the formulas dealing with lens and applying them in exercises. The students' weakness in mathematical skills automatically affects in natural science understanding. Sometimes, students cannot finish the tasks completely because they cannot understand or memorize the basic concept of natural science they ever learned. Moreover, their intelligence does get betterment. It means that the students who have intelligence in number and logic who can understand natural science materials well. This is the thing that affects the lowness of students' learning outcomes. It is known from National Examination (UN) data in 2013/2014 that the materials to determine light disposition related to mirror or lens or optic usage in daily life are lower than other natural science materials in 43.08.

This proves that there are many students who are not able to understand the concept of the lens. Considering the importance of this concept, it is important to present a better teaching method to motivate and provide the students in developing and increasing visual-spatial intelligence and their learning outcomes. One of the possible learning strategies developed to improve visual-spatial intelligence and learning outcomes in lens materials is the development of MI-based students' worksheet. Learning with MI is planning a series of learning activities designed by adjusting the students' intelligence. Gardner asserts that there are eight types of intelligence: linguistic intelligence, mathematics-logic, visual-spatial, musical, naturalist, intrapersonal, interpersonal and kinaesthetic (Sulaiman, et al., 2011; Ahvan dan Pour, 2016).

According to Wijayanti & Arif (2015), the development of IP-based LKS MI is based on the five dominant bits of intelligence of students, namely logical-mathematical intelligence,

physical-kinesthetic intelligence, visual-spatial intelligence, interpersonal intelligence, and existential-spiritual intelligence is feasible and effective use as a teaching material for junior high school students. Furthermore, Rizal (2012) explained that the development of MI-based students' worksheet on optical tool materials could improve students' learning outcomes with an average value of 85.8 with a percentage of 81% completeness. Then for total response interest of the student to LKS MI equal to 90,6%. Similarly, the research results Maulidah and Agus (2012) found that the constructive game given as a treatment to learners can improve their spatial-visual and interpersonal intelligence. In addition, MI-based students' worksheet development received an excellent assessment from all assessors overallly got a moderate improvement with N-gain of 0.58 and students also responded well, meaning this students' worksheet was acceptable. Based on the explanation above, it is necessary to develop teaching materials that can improve visual-spatial intelligence and natural science learning outcomes, one of which is with MI-based students' worksheet. Through this students' worksheet, the students will easily understand the learning materials, so the results will be more useful for them in their environment.

## METHODS

The method used in this research is research and development (R & D) to identify students' intelligence and teaching materials needs in SMP N 2 Banda Aceh through the development of MI-based students' worksheet. The R & D method is a research approach to produce new products or refine existing products. The research design used was quasi-experimental. The study was conducted in three stages: (1) pretest, (2) learning implementation using MI-based students' worksheet for experimental class and students' worksheet without MI without pictures for control class, (3) posttest.

The population in this study is all students of class VIII SMP N 2 Banda Aceh which consists of 224 students. The sample of the study consists of students of class VIII-2 and VIII-3 selected by purposive sampling technique based on certain inputs and considerations from the science teachers who taught in the classes. Class VIII-3 consists of 27 students as an experimental class, and VIII-2 consists of 25 students as control class. The data collection used five types of instruments, namely the tasks for the test, students' worksheet validation sheet, spiritual and

social attitudes observation, test to determine the dominant intelligence of each student, and questionnaire for the students. Tasks to measure visual-spatial intelligence and students' learning outcomes on lens materials both before and after learning in the class. The data analysis of pretest, posttest, and questionnaire results of learners' learning on learning used MI-based students' worksheet.

## RESULTS AND DISCUSSION

### MI-based Students' Worksheet

In the MI-based learning process, the first step taken is to conduct the intelligence test. The test is done in both classes to find out the dominant intelligence the learners have based on the questionnaire that has been shared. In the analysis phase, to determine the MI, each learner selected three types of intelligence with the highest score. In the process of data analysis, it is found that some learners have the same score on some types of intelligence. Especially for this situation, researchers determine the four dominant bits of intelligence. The students' dominant intelligence is summed and then calculated with the percentage so the intelligence that dominates most in the class is obtained.

### Results of Visual-Spatial Intelligence and Students' Learning Outcomes

Results of visual-spatial intelligence and students' learning outcomes on lens materials were measured by multiple choice tests consisting of 13 questions. The data comparison is the mean values of pretest, posttest, and N-gain (in percent) between the experimental class and the control class. The percentage comparison diagram of the average score of pretest, posttest, and N-gain between the control class and the experimental class is shown in Figure 1.

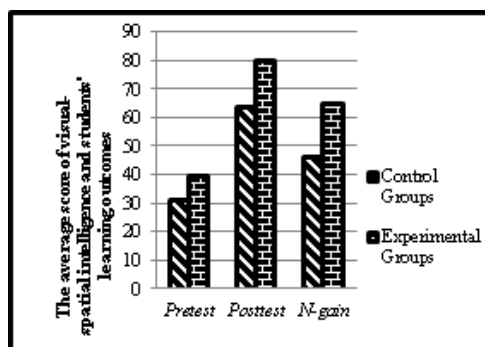


Figure 1. Average score comparison of *pretest*, *posttest*, dan *N-gain*

Figure 1 shows the percentage of the mean value of pretest result of the experimental class of 39.87 and the control class 31.06. Furthermore, the percentage of posttest average value in the experimental class is 80.04, and the control class is 63.67. N-gain of visual spatial intelligence score and experimental class learning outcome is 65 and control class is 46. The N-gain average score of a control class and experimental class is in medium category although the N-gain of the experimental class is higher than the control class. Individually reviewed, the experimental class is better than the control class. Individual N-gain ratio of students can be seen in Figure 2.

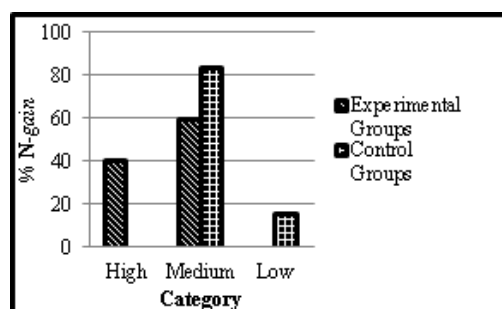


Figure 2. Individual N-gain percentage comparison.

Figure 2 shows that the percentage of normalized N-gain individually in the experimental class is categorized in a high category with 11 students (40.74%), the medium category is 16 students (59.25%), and there is no low N-gain in the experimental class. In the control class, there is no high category for N-gain. The moderate category consists of 21 students (84%), and low category consists of 4 students (16%). Furthermore, the normality test of the distribution and homogeneity of visual-spatial intelligence data and learning outcomes on the lens materials of experimental class and experimental class were performed by Lilifors test using using Ms. Excel 2010 at 0.05 significance level. Based on the pretest, posttest, and N-gain values of both classes, it is known that the data are normally distributed and homogeneous. The t-test results using independent sample test are presented in Table 1.

Based on the data in Table 1, it is known that the pretest score in two classes with  $t_{count} = 1.80$  is smaller than the  $t_{table} = 2.01$  with the significance level  $<0.05$ . It can be concluded that there is no significant difference before the learning process using MI-based students' worksheet. The posttest score is obtained from  $t_{count} > t_{table}$  ( $6,90 > 2,01$ ) that shows there is an increase in visual-spatial intelligence after given a treatment

**Table 1.** Visual-spatial intelligence and learning outcomes average difference test on lens materials

Data Source	Class	Average	Deviation Standard	$t_{\text{count}}$	$t_{\text{table}}$	Conclusion
Pretest	Experimental	39,87	19,20	1,80	2,01	The difference is not significant
	Control	31,06	16,20			
Posttest	Experimental	80,04	8,32	6,90	2,01	The difference is significant
	Control	63,67	8,74			
N-gain	Experimental	0,65	0,16	3,10	2,01	The difference is significant
	Control	0,46	0,13			

**Table 2.** Students' visual-spatial intelligence and learning outcomes test score.

Visual-Spatial Intelligence Indicator	Class Score Indicator	
	Experimental	Control
Having the sensitivity to colors, lines, shapes, spaces, and buildings.	78,70	74
Having the ability to form useful things.	85,18	56
Having the ability to visualize something, create ideas visually and spatially (in the form of pictures or visible things).	79,36	58
Having the ability to recognize object's identity from different angles.	85,18	64

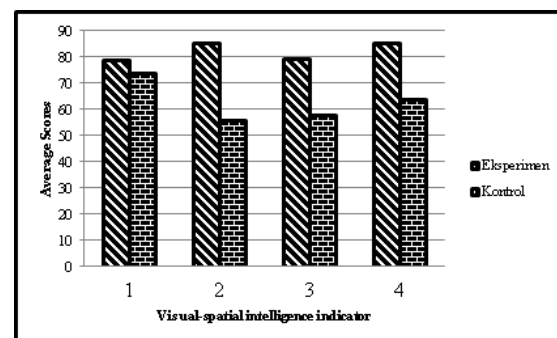
using MI-based students' worksheet. After that, the N-gain is obtained from  $t_{\text{count}} > t_{\text{table}}$  ( $3,10 > 2,01$ ) that shows that there is an increase of visual-spatial intelligence and learning outcomes of students who got a teaching with students' worksheet which is higher than the learning process in control class. The results of the data analysis above show that MI-based students' worksheet significantly influences the improvement of students' visual-spatial intelligence and learning outcomes after being treated.

### Students' Skill Based on Visual-Spatial and Learning Outcomes Indicator

The data of visual-spatial intelligence and learning outcomes of experimental class and control class learners were obtained by providing pretest and posttest using four visual-spatial intelligence indicators and learning outcomes developed into 13 questions. The tests were conducted in both experimental and control class. The average value data for each indicator is illustrated in Table 2 and Figure 3.

Based on the data of Table 2 and Figure 3, the level of visual-spatial intelligence and students' learning outcomes in lens material with four indicators representing each concept has improved on all indicators. The experimental class students' score is higher than the control class. The average score of experiments are based on the order of the high score to the low, i.e., 1) having the ability to form useful things, 2) having the ability to recognize the object's identity from

different angles, 3) having the ability to visualize something, create ideas visually and spatially (in the form of pictures or visible things), 4) having the sensitivity to colors, lines, shapes, spaces, and buildings. Seen from these results, the students' learning outcomes can be known by looking at the results of changes that occur in the students' ability. The results can be seen from the achievement of visual-spatial intelligence and learning outcomes test that have been conducted.

**Figure 3.** Visual-spatial and learning outcomes average score.

The analysis of the observation data of learning activities with students' worksheet shows that learning with students' worksheet can be done well. The students follow every step of the learning activities diligently and passionately during the learning process. All learning activities show that the learning process was done lively and well. Successful use of students' worksheet

by the students in learning is affected by students' worksheet because it contains teaching materials simpler than the model, but more complex than the lesson books. Besides it can improve visual-spatial intelligence and learning outcomes, MI-based students' worksheet also does not require students to get the same results in every aspect of assessment, but each aspect of the assessment is integrated to complement each other. So the students can grow in accordance with the skills they have. These results support the research conducted by Setyowati & Hinduan (2009) that says a student will easily understand the materials if the learning is done by paying attention to the intelligence of each student so that the learning outcomes can be better. Furthermore, it is also reinforced by research results of Arifah (2013) that says the provision of appropriate evaluation can optimize the intelligence the students have. The results of this study are also supported by Fitriyani (2014) which states that the increase of students' visual-spatial intelligence gets betterment after being given treatment. The same thing is also found in research conducted by Margaret and Gatot (2015) that says students with high visual-spatial intelligence are more prominent in the ability to visualize, present ideas visually and spatially, and orientate themselves appropriately in solving problems.

Students' attitudes were also observed by the observer during the learning process. The result of this value is used as an assessment of the students' attitudes. The observed attitudes in the form of social attitudes are responsibility, honesty, and caring, while the spiritual attitudes consist of praying before doing something, giving thanks and greeting. Zakarian (2014) stated that the 2013 curriculum emphasizes the development of the character and personality of students. The attitude competence here refers to the application of the values or students' world view and behavior. Marzuki (2012) stated that character education is not only about teaching students which one is right or wrong, but also teaching good behaviors and making them understand, do, and feel well.

Information is obtained from the observation result of social attitude assessment that the average value of the attitude of responsibility is the highest among other observed attitudes. This character enhancement is obtained because students always follow every direction and step in students' worksheet. This attitude is always instilled by students during the learning activities. Students can carry out their duties and responsibilities as they should and in accordance with

their skills and abilities, and not only expect other friends to complete the tasks (Cahyani, et al., 2014). They can participate in doing their tasks interpersonally and interpersonally. Students feel needed when they directly involve in conducting useful activities (Estrella, 2016). According to Welch (2010), students who are often involved in social activities will definitely understand what they will do in terms of establishing meaningful relationships. This is inline with the results of MI found in intrapersonal intelligence (Safitri, et al., 2013). Furthermore, Aryani (2014) emphasize that interpersonal intelligence will train students to socialize with others, because in reality, in interaction with others is very important.

The observation results on the honesty attitude show that it increased and got betterment where the observed attitude assessment through the students' actions in completing tasks given by the teacher independently. The results of this study are in line with a study done by Jaya et al. (2014) which found the development of a learning tool by integrating the character values optimally in the learning activities can improve the attitude aspects students and improve. In addition, the use of MI approach indicates a positive effect of thematic teaching on MI on learning outcome and student's character. The average learning outcomes of the experimental group are higher than the control group. Significant positive correlation between spiritual intelligence and honesty values. Intelligence and character are important in education and can not be separated because intelligence character building are the main goals of education.

Observation on caring attitude shows that it also improves to betterment. Especially in the control class, students are constantly reminded to care and help each other during learning activities. The learning process that cultivates the aspects of caring can foster mutual help in doing positive things for students such as teaching a friend who has not understood the materials in the class. This is in line with a study conducted by Kalas (2013) that asserts the learning process that invites learners to be more active in discussing difficult concepts with their friends tends to be very effective in improving the quality of learning. The obtained feedback will be very useful in improving the quality of learning in accordance with the students' needs. It also happens to three other attitude assessments in the praying before doing anything, be thankful when you're done doing something, and greet before and after class or presentation altogether increased to betterment. This is inline with Munandar's (2015) assertion

that students' worksheet is able to contribute to the students' character formation.

Each process of learning activities with students' worksheet until the learning outcomes shows learning with it is in accordance with scientific and MI approach because in it there is a process of observing, asking, gathering information, processing, and communicating. This sequence is a process done by a scientist to gain knowledge and appreciate even the smallest intelligence that a student has.

### Students' Responses after Using MI-based Students' Worksheet

The result of questionnaire data processing shows that students mostly choose Yes answer than the No answer with the average value for Yes on the questionnaire is 98.14% while the answer No is 1.851%. The most active requirement of students' worksheet is the variation of stimulus through student-centered activities. The diction used in students' worksheet is easy to understand, and interesting presentation makes students' worksheet can be studied independently by students, but it can also arouse students' interest if neatly arranged, systematic, easy to understand, and interesting. This is inline with the results of Temur's (2007), and Xie & Lin (2009) studies dealing with the MI application in learning over traditional teaching methods. Thus, it can be concluded that using MI-based students' worksheet on lens material made 27 students gave positive responses.

### CONCLUSION

This result shows an increase in visual-spatial intelligence and learning outcomes for VIII students of SMP N 2 Banda Aceh on learning lens materials through learning using MI-based students' worksheet and gave a significant increase. In addition, the responses provided by the students were also positive after learning using MI-based students' worksheet on lens materials.

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