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The Relationship Between Multiple Intelligences with Higher-Order Thinking Skills

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Abstract. This study aims to determine the relationship between multiple intelligences with higher-order thinking skills. The research sample consisted of 15 grade X students in one of the state high schools. The research method used in this research is quantitative descriptive method using correlation. The instrument used in this study was a set of questionnaires and multiple intelligence test questions as well as higher-order thinking skills tests that had been judged by expert lecturers and tested. Multiple intelligence questionnaires are used to determine the type of intelligence students have, while multiple intelligence tests and higher-order thinking skills are made according to the concept of Vertebrates. The eight types of intelligence in this study are linguistic, logical-mathematical, visual-spatial, kinesthetic, musical, interpersonal, intrapersonal, and naturalist intelligence. As a result, each student has a different type of intelligence, while linguistic and visual-spatial intelligence is a type of intelligence that is not possessed by students. Every intelligence is closely related to students' higher-order thinking skills. Students with logical-mathematical intelligence types tend to have higher-order thinking skills better than students who have other types of intelligence. The research hypothesis was tested with the Pearson Product Moment correlation formula with a = 0.05. Correlation coefficient obtained by 0.921 which means there is a very strong relationship between multiple intelligences and higher-order thinking skills.

Keywords: Multiple intelligences, higher-order thinking skills

INTRODUCTION ~ Education is one of the priorities of a country that must be improved continuously, because the progress of a country can be seen from the success of educational institutions in the form of output of human resources (Hapsari et al., 2016). Nowadays curriculum development is always done in order to increase success. The curriculum that is currently in effect is the 2013 curriculum in which demands towards developing all the potential possessed by students relating to cognitive, affective, and psychomotor. The results of the study show that the current curriculum is closely related to the concept of multiple intelligences.

The 2013 curriculum contains the development of multiple intelligence dimensions which can be seen from three things including the development of competencies, namely core competencies, the approach used is the scientific approach, and the assessment system is authentic assessment (Machali, 2014). The 2013 curriculum is a competency-based curriculum, therefore curriculum development is directed at achieving the formulated competencies. One effort to achieve the curriculum is to develop students' multiple intelligences.

Gardner (1983) in his book revealed that there are no children who are stupid or smart, there are children who stand out in one or several types of intelligence.

Everyone has intelligence with different levels of development. Gardner (1983) rejects the assumption that humans are individuals who only have a single intelligence, the results of his research show that there is no human activity that uses only one type of intelligence, but all intelligence. Every intelligence works together, as an integrated whole. Overall the most prominent of all intelligence will control other intelligence in carrying out activities, one of which is solving problems (Liliawati et al., 2018).

Armstrong (2013) suggests eight types of intelligence that can be developed by each individual, namely linguistic, logical-mathematical, visual-spatial, kinesthetic, musical, interpersonal, intrapersonal, and naturalist intelligence. Some experts even add spiritual intelligence. Linguistic intelligence is the ability to use words or language effectively both verbally and in writing (Armstrong, 2013). An individual with high linguistic intelligence is generally characterized by a fondness for reading, writing, writing, making poetry, making scientific essays, or other activities (Uno & Squared, 2010). Logical-mathematical intelligence is related to the ability to use numbers effectively and meaningfully, as well as sensitivity to patterns and logical relationships, cause and effect statements, and others (Armstrong, 2013).

This visual-spatial intelligence is closely related to sensitivity to colors, lines, shapes, spaces, and relationships that exist between these elements and can visualize an object (Armstrong, 2013), in addition to the ability to create shapes in his mind such as making drawings, building architecture, and tend to be imaginative and creative (Uno & Squared, 2010). Kinesthetic intelligence is the ability to use the whole body to express feelings and ideas and the agility of using limbs to create or change something (Armstrong, 2013). Individuals with high kinesthetic intelligence are able to actively use parts or their entire body to solve various problems (Uno & Squared, 2010).

Musical intelligence is closely related to music, which is the ability to feel, express, change, distinguish musical forms. This intelligence includes sensitivity to tone, rhythm, melody, and color in a music (Armstrong, 2013). Interpersonal intelligence shows one's ability to be sensitive to other people's feelings, easy to socialize so it tends to understand and interact with others. Having the ability to establish friendly friendships with friends, also includes abilities such as leading, organizing, handling disputes between friends, and so on (Uno & Kuadrat, 2010).

Intrapersonal intelligence is the ability to act adaptively and understand self-knowledge and be sensitive to oneself, so as to have a picture of his weaknesses or strengths, even an awareness of his mood, motivation, temperament, desires, self-esteem, and so on (Armstrong, 2013). Some of them tend to like solitude and solitude, contemplate, and dialogue with themselves (Uno & Kuadrat, 2010).

Naturalist intelligence is a person's ability to be sensitive to the environment, they tend to like observing the natural environment such as various kinds of flora and fauna, kinds of rocks, types of soil layers, celestial bodies, and so on (Uno & Squared, 2010). Students with this intelligence will enjoy learning outside of school so they can enjoy the beauty of nature, often like to grow crops, like animals, care for nature and the environment, like to do natural activities.

The difference in intelligence possessed by each student, of course, will have implications for differences in abilities possessed by students themselves. This different intelligence will cause the handling of each student to be different and varied. Not every student masters all intelligence, but maybe a student has one or even more intelligence. In line with this, each teacher should be able to facilitate the development of every intelligence possessed by students so that student learning outcomes increase and even improve the ability to think of high-level students as demands in the 21st century.

Higher-order thinking skills must be owned and developed by students. The results of the PISA and TIMSS surveys show that students' high-level thinking skills are still relatively low. This is due to lack of reasoning, analysis, understanding, and lack of student habits to do exercises that require a high level of thinking (Leonard & Linda, 2018). Clark (2015) presents questions that contain demands for higher-level thinking relating to the cognitive domain included in Bloom's Taxonomy which focuses on mastering C4 through C6 (analysis, evaluation, and synthesis) or on Revised Bloom Taxonomy (analyzing, evaluating, and creating) . This is what makes higher-order thinking skills very necessary, because students today are required to have good problem solving skills (Abdullah et al., 2017).

One solution to develop higher-order thinking skills is through the intelligence of students. The intelligence in question is multiple intelligence. This theory states that each person has various kinds of intelligence, but with different levels of development. Intelligence is a collection of abilities and skills that are developed and developed. Through knowledge about the type of intelligence students have, it gives an idea to the teacher to more easily develop higher-order thinking skills that can facilitate learning according to the type of intelligence each student has. So this research can be used as a basis for seeing the relationship between multiple intelligences with higher-order thinking skills and to see the relationship between certain types of intelligence with higher-order thinking skills.

METHOD

The method used in this research is quantitative descriptive method with correlation analysis techniques. This research was conducted in one of the State High Schools with 15 students as samples based on convenience sampling

techniques. The instrument used in this study was a set of questionnaires and multiple intelligence test questions as well as higher-order thinking skills tests that had been judged by expert lecturers and tested. The multiple intelligence questionnaire used was adapted from Armstrong (2013), while the multiple intelligence tests and higher-order thinking skills were made referring to the concept of Vertebrates. The multiple intelligence test used is in the form of a question description and a higher-order thinking skills test used in the form of a multiple choice test with five alternative answer choices. The eight types of intelligence in this study are linguistic, logical-mathematical, visual-spatial, kinesthetic, musical, interpersonal, intrapersonal, and naturalist intelligence.

In general, the relationship between multiple intelligences and higher-order thinking skills is analyzed to determine the degree of closeness of the relationship between variables expressed by the correlation coefficient (r). Criteria for the level of strength of the relationship between variables can be seen in the value of the correlation coefficient (r) with the provisions as in Table 1 below. The relationship between these variables can be positive or negative. Correlation test can be done in parametric or nonparametric terms of the normality test.

Table 1. Criteria for the level of strength of relationships between variables

Correlation Coefficient (r)	Interpretation
0.00 - 0.25	Very weak
0.26 - 0.50	Enough
0.51 - 0.75	Strong
0.76 - 0.99	Very strong
1.00	Perfect

(Santoso, 2003)

RESULTS

Based on the results of research in general the relationship of multiple intelligences with higher-order thinking skills can be seen in the following Table 2.

Table 2. Pearson correlation test results of multiple intelligences with higher-order thinking skills

Variable 1	Variable 2	Correlation (r)	*Sig.*	Information
MI	HOTS	0,921	0,009	very strong

Information
MI: Multiple intelligence
HOTS: higher-order thinking skills

Based on Table 2, it is known that the correlation test used is the Pearson correlation test, this is because the data is normally distributed. The result is that the

correlation between multiple intelligences and higher-order thinking skills has a very strong correlation of 0.921 with Sig. 0.009 <0.050 which means that the relationship between these variables is significant. It informs that if a student's multiple intelligences are good, higher-order thinking skills are also good.

Based on the results of research on multiple intelligence questionnaires that each student has a different type of intelligence. Every student has at least one type of dominant intelligence, in fact there are some students who have more than one dominant intelligence. The results of the multiple intelligence questionnaire used only focus on one of the most dominant types of intelligence possessed by students. The results are generally interpersonal and intrapersonal intelligence is a type of intelligence that is widely owned by students while linguistic and visual-spatial intelligence is a type of intelligence that is not possessed by students. The results of multiple intelligence tests and higher-order thinking skills describe quantitative data of multiple intelligence and higher-order thinking skills of students relating to the concept of Vertebrates. In general, the results can be seen in the following Table 3.

Table 3. Recapitulation of types of intelligence, the value of multiple intelligences and the value of higher-order thinking skills

Student Code	Type of Intelligence	MI Value	Average MI Value	HOTS Value	Average HOTS Value
S A	Logic	93	93	50	50
S B	Kines	87	71	50	30
S C	Kines	55		10	
S D	Musical	62	62	10	10
S E	Inter	73	78,5	65	38,75
S F	Interl	92		50	
S G	Inter	87		30	
S H	Inter	62		10	
S I	Intra	76	84,5	55	35
S J	Intra	83		35	
S K	Intra	94		25	
S L	Intra	85		25	
S M	Natur	91	76,7	35	25
S N	Natur	55		35	
S O	Natur	84		5	

Information
MI : Multiple intelligence
HOTS : higher-order thinking skills

Based on Table 1 the results of research on the multiple intelligence questionnaire found that as many as 1 student (6.7%) had logical-mathematical intelligence, 2 students (13.3%) had kinesthetic intelligence, 1 student (6.7%) who has musical intelligence, 4 students (26.7%) who have interpersonal intelligence, 4 students (26.7%) who have intrapersonal intelligence, and 3 students (20%) who have naturalist intelligence. As for linguistic and visual-spatial intelligence, both are not owned by students.

The highest intelligence test results obtained the highest results, namely 94 in K students who have interpersonal intelligence and then student A who has logical-mathematical intelligence with a value of 93. While the lowest results are 55 in students C and N who have kinesthetic and naturalist intelligence. The highest level of thinking ability test results obtained the highest result is 65 in E students who have interpersonal intelligence and then students I who have intrapersonal intelligence with a value of 55. While the lowest results are 5 in students O who have naturalist intelligence.

The results can generally be seen that students with logical-mathematical intelligence have higher intelligence and higher levels of thinking ability compared to students who have other types of intelligence. Whereas students with musical intelligence have lower intelligence scores and higher levels of thinking ability compared to students who have other types of intelligence. Sequentially a positive relationship between types of intelligence on the value of multiple intelligences and the ability to think at a higher level, namely logical-mathematical, intrapersonal, interpersonal, naturalist, kinesthetic, and musical intelligence. In line with the results obtained it can be concluded that the type of intelligence students have is related to general intelligence in general and higher-order thinking skills.

DISCUSSION

Based on the results of the correlation test (Table 2), the results show a very strong relationship between students' multiple intelligences with high-level thinking skills. It informs that it would be very good and effective if in learning, specifically biology or science applying the concept of multiple intelligences in the learner. This is in line with Hopper and Hurry's (2000) research that multiple intelligences theory is a powerful tool that can help achieve educational goals more effectively.

Multiple intelligences or multiple intelligences consist of several intelligences in them ranging from linguistic, logical-mathematical, visual-spatial, kinesthetic, musical, interpersonal, intrapersonal, and naturalist intelligence. Knowledge about the type of intelligence students have will greatly help teachers facilitate learning with the learning styles of each student, even able to help students who have

difficulty with a focus on the potential of students rather than imposing using the same way to each student. Shahrokhi et al. (2017) revealed that multiple intelligences must be applied in education to meet the needs of all students.

The application of multiple intelligence theories in learning makes learning activities more attractive for both teachers and students so that they make a positive contribution to improving student performance itself (Petruta, 2013). Each student is unique and has a different type of intelligence and intelligence development. The dominant intelligence usually influences the student in solving problems related to the problems faced or learned (Suparno, 2004; Campbell et al., 2006). Based on the results that have been obtained that there is a very strong relationship between multiple intelligences with higher-order thinking skills, the results obtained can describe in more detail that certain types of intelligence that students have are associated with higher-order thinking skills.

Based on the results in Table 3 it is known from the 15 students who are samples of this study, each student has their own type of intelligence. The type of intelligence students have is the most dominant intelligence based on the results of the multiple intelligence questionnaire. The results generally show that students with logical-mathematical intelligence are students with high scores on multiple intelligences and high-level thinking skills, then students with intrapersonal intelligence, students with intrapersonal intelligence, students with naturalist intelligence, students with kinesthetic intelligence and finally students with intelligence a musical is a student who has low scores on multiple intelligences and high-level thinking skills.

The results obtained inform that the type of intelligence students have is associated with higher-order thinking skills or it can be said the type of intelligence students have has an influence on the ability to think at a higher level. High-level thinking skills used in this study are in the form of multiple choice questions with cognitive levels C4 (analyze) and C5 (evaluate). C4 cognitive level or analyze is an ability that is classified including the ability to think at a higher level, because the analysis process is a process of breaking down or breaking down a problem into smaller parts (components) and being able to understand the relationship between these parts (Anderson & Krathwohl , 2010). King et al. (2015) states that the ability to think analytically is influenced by an individual's ability to apply, re-arrange, and add knowledge to the situation or environment in which the individual is. Analytical skills are influenced and supported by information search to find information that is used in solving a problem.

C5 cognitive level or evaluating is the ability to judge which refers to certain criteria and standards. Among them are being able to provide an assessment of

solutions, ideas with suitable criteria or standards, make hypotheses, criticize and test, and accept or reject a statement based on established criteria (Anderson & Krathwohl, 2010). The ability to think at a high level collaborates the ability of the left brain and the right brain in thinking which functions as an observer of the form of problems using the left brain and as a way out more widely by using the right brain (Leonard & Linda, 2018).

Students with logical-mathematical intelligence have the highest level of ability to think among students with other intelligences. This is because logical-mathematical intelligence is intelligence related to classifying objects in several categories, identifying logical relationships between events, and carrying out certain quantitative calculations to identify real relationships between events (Korkmaz, 2016). Students who have high logical-mathematical intelligence tend to be able to understand a problem and analyze and solve it appropriately (Suhendri, 2012).

Logical-mathematical intelligence has a positive and significant influence on learning outcomes. High learning outcomes can be used as positive reinforcement. This positive reinforcement makes students have the desire to regain higher learning outcomes, naturally students become more routine learning and ultimately have high learning discipline as well. Logical-mathematical intelligence generally uses the left brain in thinking because the left brain indirectly requires students to think mathematically using logical reasoning (Leonard & Linda, 2018).

The thought process and the characteristics of logical-mathematical intelligence are closely related to higher-order thinking skills because in higher-order thinking skills students must be able to use reasoning and logic in order to solve problems correctly and correctly. This shows that the thought process in developing higher-level thinking skills is also more or less almost in harmony with logical-mathematical intelligence. This proves that there is a true relationship between logical-mathematical intelligence and higher-order thinking skills.

Intrapersonal intelligence is the second type of intelligence that has a relationship with higher-order thinking skills. Students with intrapersonal intelligence are students who understand their own strengths and weaknesses. Intrapersonal intelligence related to the right brain. This intelligence is largely influenced by the internal factors of the students themselves, namely the ability of self-knowledge, the ability of adaptation (Gardner, 1983; Suparno, 2004; Campbell et al., 2006), accurate self-representation (including strengths and limitations) that enable a person to manage his life effectively (Shearer, 2009).

The research findings of Foong et al. (2012) stated that the majority of students who have high intrapersonal intelligence are those who have high achievement because they understand their own goals

and hobbies. Students have personal instincts, are motivated and more confident. Intrapersonal intelligence is also closely related to the ability to think at a higher level, because students who already know themselves, consciously or unconsciously, they will continue to try to maximize their strengths and minimize their shortcomings. The process of thinking is thus in harmony with the ability to think at a high level that is able to solve problems with the ability to judge which refers to certain criteria and standards.

Interpersonal intelligence is the third type of intelligence that has a relationship with higher-order thinking skills. Interpersonal intelligence is the ability to understand and interact effectively with others such as the ability to lead larger groups and have the skills to solve problems (Khadijah, 2016). This is in line with research by Lunenburg and Lunenburg (2014) which suggests that interpersonal intelligence is the ability to distinguish and respond appropriately to the moods, emotions, motivations, and desires of others.

Students with interpersonal intelligence usually have a leadership spirit, are good at working together, and are fond of attending extracurricular activities at school. The thought process and characteristics of students with interpersonal intelligence are aligned with higher-level thinking skills, this is because students with this intelligence will try to solve problems by getting information from various sources, able to collaborate their thoughts so that they answer problems better.

Naturalist intelligence is the fourth type of intelligence that has a relationship with higher-order thinking skills. 3 students out of 15 students have naturalist intelligence, this intelligence involves the ability to relate to the natural environment, both in identification and observation (Sulaiman et al., 2010). This is in accordance with the findings of Marwah (2017) showing that the naturalistic intelligence of students is classified as high due to several factors, namely students who have biological talents have high environmental intelligence, attachment and student interest in learning by interacting with nature is very large.

Naturalist intelligence is closely related to students' enjoyment of interacting with nature whether animals, plants, or other inanimate objects. This type of intelligence has characteristics that are almost related to higher-order thinking skills because in higher-order thinking skills students must be able to connect something they see with their daily lives, and should even be able to take valuable lessons to solve problems better. This ability is one of the abilities associated with higher order thinking skills.

Kinesthetic intelligence is the fifth type of intelligence that has a relationship with higher-order thinking skills. Kinesthetic intelligence is the ability of a person to combine physical and mind so as to produce perfect movement. This means that kinesthetic intelligence is good

coordination between nerves (mind) with other bodies (Suyadi, 2014). Students with this intelligence are usually adept at doing sports. Students with kinesthetic intelligence have a less close relationship with higher-order thinking skills. It can be seen that students with kinesthetic intelligence have a value of multiple intelligence and the ability to think high-level is not good.

Musical intelligence is the sixth type of intelligence that has a relationship with higher-level thinking skills. Students with musical intelligence have a close relationship with higher-order thinking skills. It can be seen that students with musical intelligence have the lowest value of multiple intelligence and the ability to think at a higher level. Students who have musical intelligence use their right brain more in thinking because musical intelligence can train students to be more creative in finding solutions to various problems. Students who have musical intelligence in themselves will be able to improve the function of the right brain in thinking more broadly than before.

According to Yunus (2014) right brain thinking patterns use intuition and look for new and other ways of looking at problems, moving out, not necessarily sequentially, and flexibly. The statement explains students who have musical intelligence who indirectly use their right brain in thinking will be able to use their intuition, can find new ways with broad new steps in solving problems especially those that require high creativity, able to move out by seeing the problems of the other side is different, it does not have to be sequential or according to procedure in finding a solution to a problem, and flexible in interacting with the aim of finding the cause and effect of the problem. The tendency of the use of the right brain which is more dominant on intelligence makes students think more creatively, but is less focused on solving problems correctly because thinking is more flexible and sometimes not in accordance with proper procedures.

The ability to think at a higher level will increase if there is continuity of the left brain and right brain. Students who have multiple intelligences together will increase their ability to think at a higher level as well as students who have logical-mathematical intelligence will increase their ability to think at a higher level because the use of the left brain plays a role in higher order thinking skills. However, students who only have musical intelligence cannot influence the higher-order thinking skills of students.

CONCLUSION

Multiple intelligence is associated with higher-order thinking skills, a very strong correlation proves that if students' multiple intelligence is good, it will be good for high-level thinking skills. In addition, certain types of intelligence have a relationship or influence on higher order thinking skills. Students with logical-mathematical intelligence are closely related to higher-

order thinking skills, which tend to have higher-order thinking skills better than students who have other types of intelligence.

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