The Effect of Multiple Intelligence-based Learning Strategies, Mathematical Logic and Naturalist toward Cognitive Learning Outcomes and Biological Retention of Students Grade X on Environmental Pollution Material

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Abstract. This study has purposes to: (1) determine the effect of learning strategies Logical-Mathematical (LM) on the learning outcomes and retention of students, (2) determine the effect of learning strategies of Naturalist (N) on the learning outcomes and retention of students, (3) determine the effect of the combination of learning strategies of Logical-Mathematical and naturalist on the learning outcomes and the retention of students. This study was a quasi-experimental research. The population in this study were all students of grade X SMA 6 Yogyakarta. The instrument used to collect the data was in the form of a multiple choice test to determine the mathematical and essay to determine the naturalist ability of students. Tests on the effect of learning strategies based Intelligence multiple logical mathematical and naturalist was conducted by using One Way Anova. The results of this study indicated that (1) The learning strategy of LM has an effect on the learning outcomes and retention of students, (2) learning strategies of N has an effect on the learning outcomes and has no effect on the retention of students, (3) the combination of learning strategies of LM and N did not affect the learning outcome of students but the has an affect on the retention of students.

Keywords: Multiple intelligence; Logical mathematical; Learning outcomes; Naturalist; Retention.

1. Introduction
Educational success can not be separated from the ongoing learning process, in which includes several interrelated components. The components are teachers (educators), students (learners), materials (materials), media (equipment/facility), and the delivery method or pattern. A teacher in the learning process required to create and use a variety of methods, so that learning is not boring for the learners. There are indications that the learning process is now often deviate from the essence of education with logic mixed.

The idea of Howard Gardner on multiple Intelligence, is one of the monumental ideas in understanding "that education is changing". The concept of multiple Intelligence is one of the most significant developments and promising in adult education, based on his monumental work, Frames of Mind [1] by Jasmine. There is a statement that "If his IQ is high, then the person will be successful in learning and..."
ultimately successful in real life", this is not always true [2]. Traditionally, intelligence is considered common capabilities found in varying degrees in all individuals and especially very important in order to succeed well in school. Intelligence is always negotiated in the context of the range of fields and disciplines currently represented in the school and the community in general. Although originally based on a potential biological, intelligence inevitably expressed as a result of a combination of genetic and environmental factors [3].

Uno and Umar in [4], expressed an opinion on that intelligence is defined as, "An intelligent act is one cause an approximation to the conditions optimal for an organism's survival. In other word's intelligence Allows Effectively an organism to deal with environment ". Amstrong said, that the intelligent if it has a high test results in intelligence test known as the intelligence test (Intelligence Test) method Binnet. Gardner does not view human intelligence based on a standardized score test simply because intelligence tests only detect intelligence linguistic and mathematical logic, but Gardner looked at the intelligence and explained as follows: (1) the ability to solve problems that occur in human life, (2) the ability to produce new issues to be resolved, (3) the ability to create something or offer a service that will give rise to the award within one culture [5].

Intelligence possessed by each individual is believed to have a different intensity. Furthermore, the study of this theory will be discussed in more detail on the intelligence Logical Mathematical and Naturalist. As revealed by Buxton in [6], "this is the intelligence that is usually connected to science, and the richest science learning activities will naturally rely on logical mathematical thinking". Mathematical intelligence is the ability with respect to a series of reasons, recognize patterns and rules. This intelligence refers to the ability to explore patterns, categories and relations with manipulating objects or symbols to experiment with a controlled and orderly manner. Kezar and Williams respectively in [7] [8] points out that "The logical/ mathematical Intelligence is an ability to analyze problems carefully, to skillfully manipulate mathematical processes, and to use the scientific method rigorously. Philosophers, mathematicians, and scientist show strength in this intelligence ".

Naturalist Intelligence Gardner adds to his list in 1996. The naturalist intelligence is an ability to extinguishing varieties of plants and animals and to amass knowledge of the working of the external world. Environmentalist, fisherman, and gardeners display strength in this intelligence. According to Buxton in [6] stated that "Natural: this Intelligence Clearly this is related to science learning as well as to the intersection of science and art. look for opportunities for students to identify plants and animals; build animal habitats; plant and study a school garden; take care of a pet class; study the changing seasons, the weather, the stars, and the moon; go on nature walks class; and let students read and work outside when possible ". In the application of multiple Intelligence learning strategy in order to obtain optimal results, namely: empowering all types of intelligence in each subject and optimizing the achievement of certain subjects based on intelligence that stands on each learner.

The ability of learners also determines the success of learners in get the cognitive learning. Success or failure of a person in learning can be identified by the assessment, in order to know the results obtained by the learners after the learning process. According to Purwanto in [9], "the cognitive learning are behavioral changes that occur in the area of cognition". Tengku in [10] furthermore, according to Gagne: The learning result is a capability or ability obtained from the learning process can be categorized into five types: (1) verbal information (verbal information), (2) intellectual skills (intellectual skills), (3) cognitive strategies (cognitive strategies), (4) attitude (attitude), (5) motor skills (motor skills). Savin-Baden and Major in [11] stated that "Cognitive theories are directly concerned with the mental processes (which include insight, information processing, memory and perception) rather than products (behavior) ".

The theory of multiple Intelligence provides an ideal context to make sense of students' cognitive ability. Develop one or all of the intelligence is to facilitate the development of students' ability to think. Bloom's Taxonomy provides a similar control mechanism through which one can assess how deeply the minds of
students has been mixed with multiple Intelligence curriculum [12]. The assessment and measurement of
learning outcomes is done by using the test results to learn, especially the cognitive learning with respect
to mastering the teaching materials in accordance with the purpose of education and teaching. Is a
culmination of learning outcomes and learning process, where the results of this study will ultimately
measure the extent of this educational and teaching objectives have been achieved [13]. Help students
retain what they have learned, it seems to be one of the most pressing education issues and unresolved.
The theory of multiple Intelligence provides a useful perspective on the classic problem of education. New
perspectives on memory showed that students with "bad memory" may have a bad memory in one or two
intelligence [12].
Retention is information absorbed and can be revived or remember some time later. Retention rate is the
number of performance is still able to display student after the lapse of a certain time period, or by using
the conception of memory theorist, the amount of information they were able to remember or expressed
again by students after a certain time interval so that the higher the retention means more effective
learning, Degeng in [14] retention is very important in learning because of the absence of retention, there
is no evidence showing that there was a learning process. Retention also has a very big role in measuring
the success of student learning.
Motivated from aforementioned explanation, it can be concluded that the retention of students are given
the ability of the students of the material that has been studied in a certain period. Retention also has a
very big role in measuring the success of learning. Hence, testing the effect of Multiple-based learning
strategies Intelligence; mathematical logical and naturalist on learning outcomes and student retention
interesting to be explored.
The rest of this paper is organized as follow: Section 2 describes the proposed research method. Section 3
presents the obtained results and following by discussion. Finally Section 4 concludes this work.

2. Research Method
This study was quasi-experimental research with quasi Experiment design with pretest-post-test design.
The instrument used to collect the data was in the form of a multiple choice test to determine the
mathematical and essay to determine the naturalist ability of students. The samples in this study from four
classes of grade X out of 7 classes with random sampling, which consists of first X as an experimental
class for learning methods of logical mathematical, second X as an experimental class for learning
methods of naturalist, third X third as an experimental class for a method of learning strategies of
mathematical logical and naturalist, and last, the fourth X as an experimental class for conventional
learning. Each class consists of 28 students.
The data collection technique in this study was a pretest and post-test that was in the form of a multiple
choice test and essay used to determine the ability of logical mathematical and naturalist of learners. The
test of hypothesis was one by using One Way Anova. Before performing the test hypothesis, the
requirement must be completing, that the data to go through the tests of normality and homogeneity of
variance.

3. Results and Discussion
This section presents the results obtained and following by discussion.

3.1 The Description of the Measurement Results of Student Learning Outcomes
Learning outcomes measurement data consists of the initial score before the learning and measured by
using an instrument in the form of multiple-choice test consisting of 20 questions. The tests were
performed before and after the implementation of learning activities on the subject matter of
environmental pollution. The following Table 1 shows the description of the measurement of pretest and post-test on the learning outcomes of students in each class.

Table 1. The Description of the Measurement Result of Students Learning Outcomes

| Description | Scores Measurements Student Results |
|-------------|-------------------------------------|
|             | LM  | N   | LM + N | CONTROL |
|             | Pre | Post | Pre | Post | Pre | Post | Pre | Post |
| Average     | 18.39 | 91.96 | 19.11 | 90 | 15.71 | 76.96 | 19.10 | 75.71 |
| Maximum     | 30  | 100  | 30  | 100  | 30  | 90  | 25  | 90  |
| Minimum     | 10  | 80   | 10  | 75   | 10  | 65  | 10  | 55  |
| Standard    | 5.452 | 6.85 | 4.917 | 7.69 | 5.03 | 6.85 | 4.72 | 7.78 |
| Deviation   | Improvement | 73.57 | 70.89 | 61.25 | 56.61 |

Based on the Table 1 above, it can be seen that between pretest and post-test on both the minimum value and the maximum value of students in the class of LM, N, LM and N and control class showed that there is an increase in the value of students learning outcomes. The increase in the average value of students learning outcomes in this study are contained in the LM class (73.57), N class (70.89), LM and N class (61.25) and also control class (56.61).

3.2. The Description of Measurement Results of Student Retention

Data retention measurement consists of the initial score before the learning and measured by using a test instrument which consists of five questions. The tests were performed before and after the implementation of learning activities on the subject matter of environmental pollution. The data of retention measurement consists of the initial score before the learning and measured by using a test instrument which is in the form of essay which consists of five questions. The tests were performed before and after the implementation of learning activities on the subject matter of environmental pollution. The following Table 2 shows the description of the measurement of pretest and post-test of the retention of students in each class.

Table 2. The Description of Measurement Result of Student Retention

| Description | Measurement of Student Retention Score |
|-------------|---------------------------------------|
|             | LM  | N   | LM + N | CONTROL |
|             | Pre | Post | Pre | Post | Pre | Post | Pre | Post |
| Average     | 7.14 | 83.57 | 2.85 | 81.42 | 3.57 | 76.42 | 3.57 | 62.14 |
| Maximum     | 40  | 100  | 20  | 100  | 20  | 100  | 20  | 100  |
| Minimum     | 0   | 40   | 0   | 60   | 0   | 20   | 0   | 20   |
| Standard    | 11.17 | 17.25 | 7.12 | 13.25 | 7.80 | 23.12 | 7.80 | 19.88 |
| Deviation   | Improvement | 76.43 | 78.57 | 72.85 | 58.57 |

Based on the above table, it can be seen that between pretest and post-test on both the minimum value and the maximum value of students in the class of LM, N, LM and N and control class, showed an increasing on the value of students retention. The increase in the average value of students retention in this study are contained in the LM class (76.43), N class (78.57), LM and N class (72.85) and also control class (58.57).
3.3 Hypothesis Test Results

Prior to test hypotheses of learning strategy which is more influential on the results of learning outcomes and retention, univariate assumptions test was first conducted. The test of assumptions (prerequisite test) which was conducted consists of normality test and homogeneity test. Furthermore, to determine the homogeneity of each variable, it can be used Levene's test. The criterion of Levene’s test decision is that if the probability value (significance) of each variable is > 0.05, therefore, it is stated as homogeneous (see Tables 3 and 4).

| Table 3. Normality Test Results Before Treatment |
|-----------------------------------------------|
| Class | Learning outcomes | Conclusion | Retention | Conclusion |
|-------|------------------|------------|-----------|------------|
| LM    | 0.007            | Abnormal   | 0.010     | Normal     |
| N     | 0.000            | Abnormal   | 0.000     | Abnormal   |
| LM + N| 0.000            | Abnormal   | 0.126     | Normal     |
| Control| 0.000           | Abnormal   | 0.119     | Normal     |

| Table 4. Normality Test Results After Treatment |
|-----------------------------------------------|
| Class | Learning outcomes | Conclusion | Retention | Conclusion |
|-------|------------------|------------|-----------|------------|
| LM    | 0.035            | Abnormal   | 0.000     | Abnormal   |
| N     | 0.036            | Abnormal   | 0.000     | Abnormal   |
| LM + N| 0.045            | Abnormal   | 0.000     | Abnormal   |
| Control| 0.031           | Abnormal   | 0.000     | Abnormal   |

The Tables 3 and 4 above shows that data on learning outcomes showed no significant value > 0.05 so that it can be concluded that the data on learning outcomes are not normally distributed before and after treatment. On the data of retention before treatment, only on N class which has the data that were not normally distributed, meanwhile, after treatment all the data were not normally distributed. The test of homogeneity of this variable was used to determine the data that were analyzed had a relatively small variance. The following Table 5 shows are the results of the homogeneity test:

| Table 5. The Results of Homogeneity analysis test before treatment Using Levene's Test |
|-----------------------------------------------|
| Variables measured | Value Sig. | Conclusion |
| Learning outcomes  | 0.729      | Homogeneous |
| Retention           | .111       | Homogeneous |

In the above table, it can be seen that the probability value for the variable of learning outcomes at .729 and for retention is equal to .111. This indicated that the data before the treatment that was used on both variables have the same variance or said to be homogeneous. Meanwhile, the homogeneity test results after treatment with Levene's test obtained result as can be seen in the following Table 6.
Table 6. The Results of Homogeneity analysis test after Treatment Using Levene's Test

| Variables measured | Value Sig. | Conclusion   |
|--------------------|------------|--------------|
| Learning outcomes  | 0.906      | Homogeneous  |
| Retention          | 0.023      | Inhomogeneous|

The Table 6 above shows that the value probability (sig.) For the learning outcome variable is equal to 0.906 and homogeneous. Whereas, for the retention of a variable probability value (sig.) Is equal to 0.023 and does not have the same variance or stated as not homogeneous.

3.3.1 Hypothesis test of learning outcomes

From the above assumption, the measurement data of student learning outcomes do not meet the test requirements, ie the data is not normal and variant data group is homogeneous, so that the data of student learning outcomes will be tested hypotheses by using the non-parametric Kruskal-Wallis test by using SPSS is shown in Table 7 below.

Table 7. Kruskal-Wallis test results of the learning strategies on the Learning Outcomes

| Data Measurement Learning Outcomes | Significance | Conclusion          |
|-----------------------------------|--------------|---------------------|
| pretest                           | 0.049        | significantly different |
| post-test                         | 0.000        | significantly different |

Based on the Table 7 above, the significant value of the data pretest before the learning is (0.049), less than the significance level of 0.05 (Ho is rejected), so that there is a difference between the average value of each class. It means that student learning outcomes among classes were different before the learning process. The significance value for the data post-test after learning is (0.000), less than the significance level of 0.005 (Ho is rejected), so that there is a significant difference in the average value of post-test among classes. This means there is a significant difference from the average value among classes. Kruskal-Wallis test results showed no difference in effect prior learning strategies on student learning outcomes, then a further test was conducted to determine the effect of each learning strategy on learning outcomes. Further test results influence learning strategy on learning outcomes by using Mann-Whithney presented in the Table 8.

Table 8. The results of a further test on the effect of learning strategies on learning outcomes

| Learning Strategies | significance | Conclusion     |
|---------------------|--------------|----------------|
| LM                  | 0.000        | Take effect    |
| N                   | 0.000        | Take effect    |
| LM + N              | .750         | No effect      |

According to the Table 8 above, the data comparisons of post-test on learning outcomes LM class compared to the control class generate significant value (0.000) which is less than the significance level of 0.05 (Ho is rejected), so that the data of post-test on student learning outcomes of LM class was significantly different compared to the control class. It can be interpreted that the implementation of learning strategies of LM has significant effect on students learning outcomes. The data comparison of post-test results of learning outcomes of N class compared to control class generates significant value (0.000) which is less than the significance level of 0.05 (Ho is rejected), so that the data post-test of
learning outcomes of N class was significantly different compared to the control class. It can be interpreted that the implementation of N learning strategy has significant effect on students learning outcomes. The comparison of the average data of post-test of LM + N class compared to control class generate significant value (0.750) greater than the level of significance of 0.05 (Ho accepted), which means the data of post-test of learning outcomes LM + N has no significant different compared to the control class. It can be interpreted that the implementation strategy of LM + N has no effect on student learning outcomes.

3.3.2 Hypothesis test of retention
From the above assumption, the measurement data of students retention does not meet the test requirements, ie the data is not normal and variant data group is not homogeneous, so that the data retention of students will be tested hypotheses using the non-parametric Kruskal-Wallis test with SPSS is shown in Table 9 below.

Table 9. Kruskal-Wallis test results of learning strategies on the retention

| Data Measurement learning Outcomes | Significance | Conclusion          |
|------------------------------------|--------------|---------------------|
| pretest                            | 0.025        | significantly different |
| post-test                           | 0.005        | significantly different |

According to the Table 9 above, the significant value to the data pretest before the study (0.025) is less than the significance level of 0.05 (Ho is rejected), so that there is a difference between the average value of each class. It can be interpreted that the retention of students between classes before learning was different. The significance value for the data of post-test after learning (0.005) equal to the significance level of 0.005 (Ho is rejected), so that there is a significant difference in the average value of post-test among classes. This means that there is a significant difference from the average value among classes. Kruskal-Wallis test results showed no difference in the effect of prior learning strategy on student retention, then a further test was conducted to determine the effect of each learning strategy on the retention. Further test results influence the retention of learning strategies using the Mann-Whitney presented in the Table 10.

Table 10. Results of further tests on the effect of learning strategies on learning outcomes

| Learning strategies | Significance | Conclusion |
|---------------------|--------------|------------|
| LM                  | 0.008        | Take effect |
| N                   | 0.280        | No effect  |
| LM + N              | 0.002        | Take effect |

According to the Table 10 above, the comparison of data post-test of retention of LM class compared to control class generate significant value (0.008) which is less than the significance level of 0.05 (Ho is rejected), so that the data post-test of retention in LM class students was significantly different to the control class. It can be interpreted that the implementation of learning strategies LM has significant effect on student retention. The result of comparison of data post-test of learning outcomes of N class compared to control class generates significant value (0.280) greater than the significance level of 0.05 (Ho accepted), so that the data of post-test of retention of N class are not significantly different compared to the control class. It can be interpreted that the implementation of learning strategies of N has no significant effect on student retention. The comparison of average data of post-test of LM + N class
compared to control class generate significant value (0.002) which is less than the level of significance of 0.05 (Ho is rejected), means that the data retention of post-test of LM + N class was significantly different compared to control class. It can be interpreted that the implementation of strategy of LM + N has effect on student retention.

4. Conclusion
This paper has presented the effect of multiple intelligence-based learning strategies, mathematical logic and naturalist toward cognitive learning outcomes and biological retention of students grade X on environmental pollution material. From the results obtained that conclusions can be drawn are described as follow: Learning strategies Logical-Mathematical (LM) has effect on learning outcomes and retention of students of grade X on the subject matter of environmental pollution since students understand that learning mathematical logical not only in mathematics but also can be applied to life, learning strategies of Naturalist (N) affects the learning outcomes and has no effect on the retention of students of grade X in the subject matter of environmental pollution, the combination of learning strategies LM + N did not affect the learning outcomes of students of grade X on the learning materials of environmental pollution and the combination of learning strategies LM + N effect on the retention of students of grade X on the learning materials of environmental pollution.

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