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Students' multiple intelligences empowering to solve the problem through plasma cluster strategy

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Abstract
The empowerment of each student multiple intelligences in the 21st century is indispensable in the learning process. It is very useful to explore students' ability in problem solving that using their intelligence. The aim of this study was to clarify the effect of plasma cluster strategy based on multiple intelligences to empower student's problem-solving skills. The study design was quasi experiment performed using nonequivalent pretest-posttest control group design. Two groups of samples formed were student grade XI Biology class 1 as the experimental class (using plasma cluster strategy based on multiple intelligences), and student of Biology class 2 as the control class (using conventional strategy). The instrument used was the observation of implementation learning sheet, problem-solving abilities instrument and multiple intelligences questionnaire used to identify the dominant intelligence on each student. Data was collected through a pretest and posttest. Data analysis was performed with descriptive analysis, while anacova test was performed in order to test the hypothesis; further the test of Least Significant Difference (LSD) is performed. Findings of the research showed that the learning of Plasma Cluster multiple intelligences based is influences on the ability to solve problems. Meanwhile, there is an increased ability to solve the problem of students being treated with strategy of Plasma Cluster based multiple intelligences by 41.79% higher than the conventional strategy by 18.46%. Related to this conclusion, the researcher suggests that teachers would use Plasma Cluster with multiple intelligences based consistently because it has proven successful to improve students' problem-solving skills.

Keywords: multiple intelligences, Plasma Cluster strategy, ability to solve problems

1. Introduction

21st century skills are a set of skills that must be owned by students and teachers in order to live successfully. In the era where the world is growing flat, borders are no longer recognizing. Therefore, everyone should show independence, but able to collaborate with others and be able to compete. Education today is faced with various challenges which are quite serious and very fundamental, especially challenges that related to the global dimension of competition. To face this competition, the sort of quality human resources that gained through quality improvement at every level of education is needed. This is in accordance with the demands of the future where it is necessary to have the skills to think and learn, and also to solve the problems. Qualified human in the 21st century are a man who has life skills, one of which is the ability to solve problems [9].

Moreover, the empowerment of problem-solving skills at every level of education is necessary, in this case at the level of high school (SMA). However, the results of observations on the November 2014 at Santa Maria Catholic High School Malang, Indonesia showed that the empowerment of problem solving skills was not optimal. It was seen during the learning process, teachers tend to ask questions that ultimately the results is in the form of a recall answer. At the time of the learning process, teachers have not brought up the phenomena that occur related to the materials to look for a solution. For an example, the fact that found when the observation held was teachers just ask the students to explain the mechanism of the circulatory system. Another example, teachers did not complete the learning activities in accordance with the demands of competence in the material of circulatory system which analyzes the relationship of network structure of organ constituent in the circulatory system and associate it with its bioprocess so as to explain the mechanism of blood circulation and function disorders that may occur in the human circulatory system through literature study, observation, experimental, and simulation. Such learning process has not led students on a problem that requires students to be able to formulate a problem, formulate hypotheses, collect data, test the hypotheses, draw conclusions, and recommending solutions.

Various benefits and understanding of problem solving skills have been raised by some experts. The ability to solve problems is to identify and define problems, mental representation of the problem, to plan on how to proceed, implement solutions according to the plan, evaluate, and reaction to feedback [12]. While the ability to solve problems is a basic process to identify problems, considering options and make informed choices [9]. It is used when easy answers or solutions do not exist. Observations show that the students have not been able to fully master the concepts, causing students to be less able to solve problems and lead to cognitive learning outcomes of students. The facts that occurred in Santa Maria Catholic High School Malang show that conventional strategy was still largely dominating the learning process. Learning in the classroom was still teacher centered, still using traditional learning methods such as lectures, tend to emphasize the cognitive abilities such as the ability of logic (mathematics) and linguistic (language), has not sought the empowerment of multiple intelligences in the learning process. With this sort of earning performed by teachers, it would result in the learning process, which is boredom, and uninteresting, and less prepared to follow the learning that can lead to lazy students looking for information themselves, they tend to ask the teachers who are considered as the source of

reliable information. So far, teachers only ask the students to learn, but rarely taught students how to learn, as a result they have difficult times in solving problems, make decisions, critical thinking, and creative thinking.

Plasma Cluster strategy is one of the many alternatives to solve the problems, so learning process and the results fulfill the expectations. Plasma Cluster strategy is contextual strategy. The word Plasma is an acronym of selection and mastery of competencies, while cluster means a small group that deliberately formed. The process of understanding a matter of competence conducted in groups is a cooperative learning that can help students in preparing a concept that built from each member of the study group. The group learning can help students in the mastery of competencies, with the interaction between the students, thus all acquired in the learning process will be faithful memory for the students. Learning process with group discussions strategy can generate optimism and spirit of student learning compared to individualistic learning [8].

The Plasma Cluster strategy has been adopted and developed from a blend of Problem Based Learning (PBL), Think Pair Share (TPS), and added by the use of learning resources to help students in the selection and control of the material competence in groups. Plasma Cluster strategy involves students to select and search for learning resources that can facilitate learning to achieve competence [10]. The stage of Plasma Cluster strategy based on multiple intelligences such as: 1) preparing the student to learn where students are facilitated to observe video or image related to the material to be studied. In this stage, students are required to be able to formulate a problem related to the video or image that has been prepared by the teachers, 2) building schemata, which at this stage, the teacher asks the students about the video or pictures that have been displayed and students are discuss the results obtained from the video or image that has been watched. At this stage, students are given the opportunity to formulate hypotheses, 3) grouping the students and identifying learning sources where students are asked to form groups according to the dominant intelligence possessed and make the selection of learning resources to collect data related to tasks assigned to each group, 4) setting the report and presentation, the stages which gives an opportunity to students for discussion in each group to work on student worksheet prepared by the teacher. At this stage, students are required to be able to draw conclusions, 5) presentation and discussion is the stage that provides the opportunity for each group to report the results of the discussion to the other groups and teachers. At this stage, students are required to be able to recommend solutions contained in the student worksheet.

The application of Plasma Cluster strategy is expected to increase the creative power of teachers in preparing varied learning resources, quality, fun, and innovative in teaching and learning so that students do not feel bored. Students also will stay motivated in learning, because students participate actively in the learning process in the classroom. During the learning process, students will be trained to be able to dig up information by using a variety of learning resources, and teachers can be a friend for the learning. In addition to using Plasma Cluster strategy, it is necessary also to know the multiple intelligences owned by students, because it is the key to the success of students' future.

Multiple intelligences theory asserts that every individual has different types of intelligence and that they need different methods to develop each intelligence [3]. The theory is based on the idea that intelligence is traditionally defined in terms of IQ, which measures the ability to narrow the range of linguistics and logic/math [7], but everyone has a unique way to solve problems faced. Another opinion explains that, every individual has a unique talent and potential [18]. In line with that, every person has one or more intelligence with different percentages [11]. Meanwhile, intelligence is the ability to apply one or more of the intelligences in a way that is valued by society or culture [1]. Intelligence is not only seen from the value obtained by someone. Intelligence is the ability of a person to see a problem, then solve these problems, or create products that can be useful to others. Multiple intelligences is not to label students to have only one kind of intelligence, but multiple intelligences gives a picture that every individual has 9 kinds of intelligence with a different composition and dominance.

Teachers said with the application of multiple intelligences it will give students a meaningful choice to learn and to communicate their knowledge even if the student's choice needs to be controlled [16]. Another opinion stated that, they were also actively processing information as they retrieve material from their prior knowledge and relate it to the new material in the lesson [18]. Teachers's assignment is to create a pleasant study environment and help students to use the five senses to cultivate all that intelligence. If teachers have to undertake optimally then the results obtained throughout the kinds of students' intelligence then these students will grow to high levels. Teachers can encourage the raising of the whole modality of learning, help students connect the skills and the development of various intelligence in learning at school through teachers to explore the ability of students so that intelligence would develop [21]. Meanwhile, teachers should assess students to learn in a way that it can give a true picture of the strengths and weaknesses found in students [20].

Based on the explanation above, this study conducted by applying the Plasma Cluster strategy based on multiple intelligences. This study aimed to describe this learning strategy influence on the ability to solve problems in class XI student of biology Catholic High School Santa Maria Malang.

2. Methodology

2.1 Research's Design

The design of this study was a quasi-experimental. In this experiment, the control group and the experimental group were both formed naturally from the beginning. The study design used nonequivalent pretest-posttest control group design. There were two variables of this study, i.e independent variable was the Plasma Cluster strategy based on multiple intelligences and the dependent variable is the ability to solve problems.

2.2 Population and Sample

The population in this study was using total sample because this study was taking the whole class XI Santa Maria Catholic High School Biology Malang in the academic year of 2014/2015 of even semester. The sample in this study was students of class XI Biology 1 and XI Biology 2 in Santa Maria Catholic High School in Malang. Class XI Biology 1 is a class that was used as an experimental class while the class XI Biology 2 was used as the control class. The experimental

class there has been already a form of cluster formed in accordance with the dominant intelligence (intrapersonal, interpersonal, linguistic, musical, visual, existential) obtained through a questionnaire of identification of multiple intelligences. The sampling technique was using simple random sampling technique, which was performed randomly to the assigned classes containing students with heterogeneous academic ability. Related to the number, grade XI Biology 1 was in total of 33 students and Class XI Biology 2 was in total of 38 students. Equivalence testing samples was done by using a different test criteria that there is no difference between the classes used ($p > 0.05$).

2.3 Instrument

Data collection instrument used in this study consisted of instruments for the measurement of independent variables which include: 1) learning observation sheets, and 2) multiple intelligences questionnaire which refers to [17] and instrument for the measurement of the dependent variable was an essay test. Essay test was in the form of open-ended questions used to obtain data on problem-solving skills. Essay test was then assessed using a rubric ability to solve problems that refers to [13].

3. Results and Discussion

3.1 Results

Mastery level in the indicator of the problem-solving ability includes the aspect of problem formulation, formulate hypotheses, collect data, recommend solutions, and draw conclusions. The percentage of problem-solving skills indicators of pretest and posttest can be seen in Table 1.

Table 1: Mastery level in the indicators of the problem solving ability (%)

No	Indicator	Control		Experiment	
		Pretest	*Postest*	*Pretest*	*Postest*
1	Formulating problems	44,74	50,33	48,86	69,32
2	Formulating hypothesis	44,74	53,29	51,51	60,98
3	Collection of data	32,57	44,40	37,88	62,88
4	Recommendation of problemsolving	48,02	53,62	45,83	63,25
5	Drawing conclusion	43,75	51,64	39,77	60,98

In Table 1 indicated that the achievement of mastery indicator problem-solving skills of students learn using Plasma Cluster strategy based on multiple intelligences and students who are learning with conventional stategy, in general, has increased. The supreme mastery level indicator problem-solving skills for experiments class on indicators to formulate hypotheses, which amounted to 51.51% during the pretest and on indicators to formulate the problem, which amounted to 69.32% at posttest. In contrast to the conventional class that shows mastery level data indicator problem-solving ability is highest in the indicator recommend troubleshooting, i.e. by 48.02% and 53.62% pretest-posttest moment.

The lowest mastery level indicator of problem-solving skills to the experimental class pretest on indicators to collect data, which amounted to 37.88%, whereas when posttest on indicators to formulate hypotheses and draw conclusions amounted to 60.98%. In a conventional classroom, mastery achievement indicators collected data occupies the lowest position in the pretest and posttest, with a rate of 32.57% and 44.40%.

The increase of each indicator of the ability to solve problems in the control class and experimental class after given treatment that includes the aspect of formulating the problem, formulating a hypothesis, collect data, recommend solutions, and draw conclusions. The percentage increase in indicators of problem-solving skills during pretest and posttest can be seen in Figure 1.

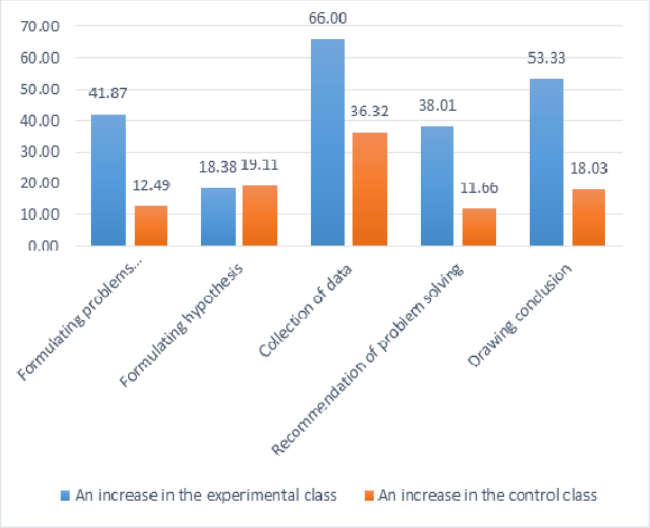

Fig 1: The Increase of Indicator Mastery of Experiment Class and Control Class

The data relating to the problem-solving skills was then tested by using a statistical test of Anacova test. In Table 2 it presents a summary of Anacova; the results of calculations of data of the problem solving skills based on the pretest and posttest.

Table 2: Summary of the Calculation of Problem Solving Skills Anacova

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Strategy	2991,348 (a)	2	1495,674	35,877	,000
Intercept	20169,253	1	20169,253	483,797	,000
XKMAS	85,411	1	85,411	2,049	,157
KELAS	2823,697	1	2823,697	67,732	,000
Error	2834,885	68	41,689		
Total	233437,500	71			
Corrected Total	5826,232	70			

The calculations show that the significance value was less than 0.05 which was equal to 0,000. This means that the null hypothesis is rejected and the research hypothesis is accepted. Thus, there is an influence of learning strategies to problem solving skills. Further testing is then performed by using Least Significant Difference (LSD), which was conducted to determine the learning strategies that provide the highest influence in improving problem-solving skills. Table 3 shows the results of a further test in the effect of learning strategies for problem-solving skills.

Table 3: Effect of Advanced Test in the Learning Strategy against Problem Solving Skills

CLASS	XK MAS	YK MAS	SELISIH	XK MASCOR	Notation LSD
1=control	42,76	50,66	7,89	50,73	a
2=experiment	44,77	63,48	18,71	63,40	b

The Table 3 shown the average of problem solving skills from each learning strategies. The average rate of the corrected of the two learning strategies, showed that the results of the ability to solve problems with conventional strategies have declined by an average of 50.73 and the results of problem-solving skills by Plasma Cluster strategy based on multiple intelligences has an average rate of corrected amounting to 63.40. Statistically it shows the differences in the rate of the problem-solving skills that occur in both learning strategies showing significant differences.

4. Discussion

The result of problem solving skills based on the pretest and posttest showed that learning strategy affects the problem solving skills. This is indicated by the value of the probability of learning strategies amounting to 0,000 or less than 0,5. It means learning strategy affects the ability to solve problems. Students who receive instruction using Plasma Cluster strategy based on multiple intelligences has the ability to solve problems higher and significantly different from the students who received conventional teaching. Based on the consistency of test results showed that the implementation of learning strategies performed consistently.

Plasma Cluster strategy based on multiple intelligences proved to be more able to improve the ability to solve problems than the conventional strategy. The analysis showed that the increased ability to solve problems in the experimental class taught by Plasma Cluster strategy based on multiple intelligences by 41.79%, whereas the increase in the ability to solve problems in class control of only 18.48%.

Plasma Cluster strategy has an advantage of prioritizing cooperation among students in selecting, determining the learning resources to achieve some competence required. It is also direct on independent learning by considering and providing the opportunity for students to determine their preferred learning resources in the learning activities. Those will make the students familiar to solve problems independently as expected such as learning required in the 21st century.

The increased of ability to solve this problem because of the characteristics of Plasma Cluster strategy based on multiple intelligences which is a blend of Problem Based Learning (PBL) and Think Pair Share (TPS). PBL helps students to develop thinking skills and problem solving skills, and become independent learners [5]. PBL trains students to develop and explore further the problem by raising their awareness about different ways of thinking for the settlement on a problem [27]. In line with the research performed by [25], PBL is based on the principle that students not only acquire knowledge but also that they know how to apply this knowledge in real situations. On the learning of PBL, students discuss and analyze the problems in a group. This causes some issues or topics require exploration. Students then use the issue or topic that has not been resolved as a guide to direct their learning activities. PBL identifies two most important criteria: 1) the extent of the problem stimulates thinking or reasoning, and 2) the extent of the problem leads to self-learning students.

Meanwhile, TPS is one of cooperative learning strategies that can empower students' thinking skills. TPS gives structure to the discussion so that the ideas and behavior of students is focused because they have to report the results to the group members. TPS approach assumes that all recitation or discussion needs to be done in setting the whole group, and has a built-in procedure to give more time to the students to think more, respond to, and help each other [4]. TPS has become an alternative because the cooperative learning strategies have processes in structure to share information efficiently. It can be used as a tool to improve the learning process. This process can be used as a guide in other learning situations that can build a foundation of knowledge and understanding [19]. In addition, TPS is an effective way to create an atmosphere variation pattern of class discussion. Meanwhile, the application of cooperative learning of TPS can enhance problem-solving abilities of learners [6].

The application of PBL can improve math problem-solving skills and creativity in students [22]. Meanwhile, the use of PBL led to a significant improvement of the students' ability to solve problems [15]. The application of TPS can improve the problem-solving skills of high school students [26]. TPS proved to enhance the students' ability in solving mathematical problems [14]. Problem-solving skills are influenced by cooperative learning. In the cooperative learning, learning is carried out by setting small groups by taking into account the diversity of the group as a forum for students to cooperate and solve problems through social interaction with their peers, providing the opportunity for students to learn something well at the same time and be a resource for other friends. Cooperative learning encourages social interaction. Social interactions occur when learning is done with this cooperative learning strategy that can improve the ability to solve problems. This is supported by the results of research stated that cooperative learning can meet the needs of students in critical thinking, problem solving, and integrate knowledge with experience [24].

There are some steps that should be done in learning by using Plasma Cluster strategy based on multiple intelligences, they are: grouping the student and identifying learning sources, namely the cluster formation. The classes are divided into several clusters according to the dominant intelligence to discuss and determine the learning resources for collecting information for discussion. Plasma cluster based on multiple intelligences is a cooperative learning that can improve the ability to solve problems because it includes activities that make the group to have a chance to talk with other students about their thinking process, it is the process of formulating the mind in order to be delivered to another person who refers to the development of capabilities to solve the problem. The increased of the ability to solve problems cannot be separated from the stage of Plasma Cluster strategy based on multiple intelligences that accommodate students to develop problem-solving skills possessed.

5. Conclusion

There is the influence of the application of Plasma Cluster strategy based on multiple intelligences against problem-solving skills in students XI Biology in Santa Maria Catholic

High School Malang. The result of Least Significant Difference (LSD) test showed that the average of students' problem solving skills treated by using Plasma Cluster strategy based on multiple intelligences is amounting to 63.40 higher than conventional strategy that is equal to 50.73. Meanwhile, an increase in students' ability to solve problems treated with Plasma Cluster strategy based on multiple intelligences by 41.79% higher than the conventional strategy that is equal to 18.46%.

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