CONFERENCE PROCEEDINGS

INTERNATIONAL CONFERENCE ON MATHEMATICS AND SCIENCE EDUCATION (ICoMSE) 2019

Malang, 27-28 August 2019

ISBN: 978-602-73915-7-4

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CONTENTS

The Epistemic Game of Students during Physics Learning by Integral Learning

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Abstract. Epistemic game is cognition process to solve the problem. The research aimed to determine the epistemic game of students during physics learning through integral learning. This research used embedded design. The subject of this research is 30 students of X MIA SMAN 3 Malang. The heat concept quiz is used in this research instrument. The results of this research show that epistemic game during integral learning application on the first quiz is mapping mathematics to meaning, physical mechanism game, recursive plug and chug, dan transliteration to mathematics. On the second quiz, students use mapping meaning to mathematics, mapping mathematics to meaning, physical mechanism game, dan transliteration to mathematics. Students solve the third quiz with mapping mathematics to meaning, physical mechanism game dan transliteration to mathematics.

Introduction

Education is one of the important factors of state authority. A good education will utter the competent students in their department. It is shown that improved conditions and rapid science expansion expect the competent students of their department. Physics is one of the science departments to be applied in all of the application department. Today, physics still has to be believed in the horrible department by students. The student understanding of the physics concept, especially the heat concept, is still low. It is shown that the previous researches still show a misconception of heat concept. Angell, et al. (Ornek, et.all, 2008: 30) said that the student perception of physics was difficult because the student had to compete with the different representations like an experiment, formula and calculation, graph with the conceptual explanation at the same time. A big part of students can not relate what studied to how knowledge will be exploited or used (Setyorini, et.all, 2011: 52).

The learning implementation is designed specially like inquiry-based activity to can overcome the student's concept incomprehension (Nottis, 2010: 8). The incomprehension of relating heat to temperature concept is found in engineering education, while the incomprehension of heat transfer concept is found after the student completed the assignment being given by the teacher. According to Baser (2006: 72), the teacher can use the student's incomprehension representation in making a new phenomenon sense to design learning for a student. The

incomprehension can be decreased by the implementation of an accurately learning approach. The learning strategy have to be designed like the student's way to have a conviction that the scientific concept is more useful than the alternative concept. The language using decreases to be understood by the student, causing to occur the concept incomprehension. It agrees on the research result of Halim, et.all. (2012: 128) said that the understanding increase of student's concept about heat energy would be better if the learning instruction use daily language compare with using the second language.

The student's incomprehension of heat concept is showed by Alwan's research result (2011: 604). The students are still confused with heat and temperature concept and can't explain heat and temperature difference. The students can't still approximate the final temperature of different temperature of two sample mixture, however the student understand the mixtured temperature being not higher than before two sample to be mixtured. The previous research said that the student could not give a reason to supporting the student's right answer. Alwan found in his research that the student could use formula and solve theoretical as well as mathematical problem, however the student don't understand the equation based concept and relate to experience.

The physics concept understanding need advanced thinking ability. Agree with Sarwi & Liliasari (2009: 91), physics concept understanding need thinking and reasoning to solve physics problem. The critical thinking ability is needed students to learn about physics phenomenon of nature by a physics concept based analysis. The developing learning method should facilitate actively thinking activity so that learning becomes efective. The previous research result shown that the student's concept understanding is still low because of the students's difficulty of their solving problem. The Subagyo et.all. research (2009: 46) said that concept understanding is still low by deeveloping of process ability and scientific attitude. Agree with Mariati (2012: 159), the student's concept understanding of interpretation aspect is still lower than another aspect because the given problem is not specific. The students will more easily build knowledge explore ideas related to concepts, deepen the concept so that ideas can be developed by problem solving process.

Physics concept understanding can not be separated from the student's cognitive process. Intrepetation of cognitive process that the students use in solving the problem to be called epistemic game. Tuminaro's reasearch result (2007) acquaint the new structure to analyze the thinking of student's problem solving. The developing of new structure is called epistemic game. Epistemic game is equal to problem solving structure. The students can become better and more efficient problem solver by increasing of understanding of knowledge and reasoning be begun to develop the efectively and efficiently circles of learning and interference by acquainting the accurate source and epistemic game (Tuminaro, 2007).

The active learning of interference can build the pleasant learning process for teacher and student and cause the student to can increase the concept understanding of cognitive process (Duron, et.all, 2006: 160). Integral learning is developed by Atkin by using the basis of whole brain model. The good learning of increasing of thinking ability should stimulate all of brain potency and integrate thinking patterns (Atkin, 2000). Agree on Hermmann's clarification, there is to relate to the thinking pattern of integral learning concept. Integral learning is learning to integrate achievement type agree on internal brain characteristics of every learning. Integral lerning focus stimulate student of learning circles that support and challenge student (attract student's attention). Integral learning implementation do not pay attention the student's thinking type, however teacher clarify the important achievement of each knowing type. The learning is become by more efective immendiacy when the processing of whole brain is accurately done inside it. The important point of integral learning is the student's powerful learning to be become when teacher stimulate and integrate all of knowing type by knowing to the power of four.

Methods

The research used embedded design. This research instrument is heat concept quiz. It is given during the physics learning of integral learning to determine epistemic game of students during the giving of concept.

Integral learning implementation consists of 6 steps. The first step is experiental knowledge to be used on the learning activity where the teacher demonstrated on the tropic of connection with heat and its temperature and form, Black principle, coduction, convection and radiation heat transfer, teacher play the bonfire video. The experiental knowledge step aimed to submit the problem of topic concept. The next steps are understanding, imagination, information and clarification. The understanding step, the students make a team for experiment preparations begin with the reading of worksheet. The student begin with setting tools and then doing experiment on the imagination step. The topic of connection with heat and its temperature and form, the student make the graph of relate temperature and time on the imagination step. Specifically for the topic of Black principle, the student drafted the experiment procedure before setting tool on the imagination step and the topic of convection heat transfer, the student make the current pattern of convection heat transfer. After doing experiment, the student notes hypotheses, experiment result and then doing team discussion to solve the problem of worksheet. The worksheet consists of concept application sheet containing the phenomenon that occur in circles and laboratory activation sheet. The concept of application sheet is given at the first until the third meeting reveal the phenomenon of cryotherapy, the waste of electric steam power plant at Paiton,

hypothermia. The next step is the student to presenting the team discussion result (the information and clarification step). The student presenting discussion result be choiced by lottery in order that every student at class has the same chance of presenting of discussion result, while the student of other team respond and teacher is facilitator and gives directive. The closed activity of learning, the student solve the problem be discussed together in front of class (the action step). The students are given quiz, besides solving the exercises at the first, second and fifth meeting on the action step. The students's quiz data are qualitative data will be analyzed descriptively qualitative so that obtained epistemic game data during learning implementation.

The quiz is given for students on the action step during learning implementation. The heat concept quiz is held three times. The first quiz is given on the learning by the topic of connection with heat and its temperature and form. The second quiz is given on the learning by the topic of Black principle. The third quiz is given on the learning by the topic of convection, conduction and radiation heat transfer.

The data of this research are qualitative and quantitative data. The quantitative data of this research are the quiz result data of student's concept understanding. The qualitative data are obtained from epistemic game data of quiz result. This data analysis refered to sequential data analysis. It consists of prepare and organize the data for analysis, code the data, represent findings, intrepent the findings and validate the accuracy of the findings.

Results

Integral learning process of this research cover the concept of connection with heat and its tempererature and form, Black principle, and heat transfer. Based on the result of quiz analysis (during learning implementation) show that the first case (the first question), the 6,67% of students use physical mechanism game on the first quiz, the 66,67% of students of the second quiz, and the 3,33% of students of the third quiz, while used transliteration to mathematics by the 93,33% students of the first quiz, the 23,33% student of the second quiz, and the 93,33% of student of the third quiz. The second case (the second question), the student use mapping meaning to mathematics to be the 0% student of the first and the third quiz, the 90% students of the second quiz, while use mapping mathematics to meaning to be the 16,67% students of the first quiz, the 6,67% students of the second quiz, and the 0% student of the third quiz. The physical mechanism game of epistemic game is used by the 0% student of the first and the second quiz, the 33,33% students of the third quiz. Recursive plug and chug is used to solve the problem by the 80% students of the first quiz and the 0% student of the second and the third quiz. Transliteration to mathematics is used to solve the second case problem by the 0% student of the first and the second quiz,

and the 53,33% students of the third quiz. The percentage of epistemic game during learning are presented in the Table 1.

TABLE 1. The Percentage of Epistemic Game during Learning

Question	Epistemic Games	Quiz 1	Quiz 2	Quiz 3
1	Mapping Meaning to mathematics	-	-	-
	Mapping Mathematics to Meaning	-	-	-
	Physical Mechanism Game	6,67%	66,67%	3,33%
	Pictorial Analysis	-	-	-
	Recursive Plug and Chug	-	-	-
	Transliteration to Mathematics	93,33%	23,33%	93,33%
2	Mapping Meaning to Mathematics	0%	90%	0%
	Mapping Mathematics to Meaning	16,67%	6,67%	0%
	Physical Mechanism Game	0%	0%	33,33%
	Pictorial Analysis	-	-	-
	Recursive Plug and Chug	80%	0%	0%
	Transliteration to Mathematics	0%	0%	53,33%

TABLE 2. The Mean Percentage of Epistemic Game during Learning

Epistemic Games	Quiz 1	Quiz 2	Quiz 3
Mapping Meaning to Mathematics	0%	45%	0%
Mapping Mathematics to Meaning	8,33%	3,33%	16,66%
Physical Mechanism Game	3,33%	33,33%	18,33%
Pictorial Analysis	-	-	-
Recursive Plug and Chug	40%	0%	0%
Transliteration to Mathematics	46,66%	11,66%	73,33%

Based on Table 1, epistemic game to solve the problem of the first quiz during integral learning implementation pada kuis 1 (the topic of connection with heat and its temperature and form) is used by student by mapping mathematics to meaning, physical mechanism game, recursive plug and chug, and transliteration to mathematics. Mapping meaning to mathematics, mapping mathematics to meaning, physical mechanism game, and transliteration to mathematics are used the student to solve the second quiz problem (the topic of Black principle). The student solve the third quiz problem (the topic of heat transfer) by mapping mathematics to meaning, physical mechanism game and transliteration to mathematics.

Discussion

The results of this research can explain that during the integral learning, the student experience the change of epistemic game. It agrees on the results of Teodorescu's research (2013) show that efforts clarify the physics problem and question in accordance with the cognitive process of problem solving still growing.

The results of this research show that the student use some game of epistemic game. Agree on the results of Tuminaro's research (2007), the cognitive model of epistemic game can increase the students's

understanding. Epistemic game is cognition process to solve the problem.

Mapping mathematic to meaning implementation during integral learning implementation is not developed very well yet. It agrees with Tuminaro (2007), the students develop the conceptual story of the physics equation of game mapping mathematics to meaning. The students begin with a physics equation and develop the conceptual story. Tuminaro identifying the four of its game step that is (1) identifying the concept target; (2) finding the equation related target concept to another concept; (3) telling story to use to relating to concepts; (4) evaluating the story.

Transliteration to mathematics is used in this research more. It is caused by this game to use the working example to resulting in the solution without the conceptual understanding development. Tuminaro identifying the four of this game step that is (1) identifying the target measurement; (2) finding the solution pattern related to the current problem situation; (3) mapping the measurement of current problem situation of solution pattern; (4) evaluating mapping.

The result of the research shows that integral learning implementation can change or develop the students' epistemic game. Epistemic game related to the students's thinking way themselves. Atkin (2008) said that an individual will develop methods to know an expressiveness of their thinking pattern. Integral learning is the learning integrates the result type of ability agree on the internal brain characteristic of every learning (Atkin, 2008: 8), that is (1) understanding definition, concept, or theory; (2) procedural ability and understanding the process skill; (3) meant to ability and application every day; (4) developing the idea of picture, model, or design form.

The student's incomprehension of the heat concept is shown by Alwan's research result (2011: 604). The student is still confusing with the heat and the temperature concept can't explain heat and temperature difference. Its research said that the student couldn't give the solution to support the right answer of a student. Alwan discovers that the students can use the formulation and solve the theoretical problem as well as mathematical problems, but they can't understand the concept of the base equation and related to experience.

Summary

The research conclusions are the epistemic game for problem-solving during integral learning implementation on the topic of connection with heat and its temperature and form is done by mapping mathematics to meaning, physical mechanism game, recursive plug and chug and transliteration to mathematics. Mapping meaning to mathematics, mapping mathematics to meaning, physical mechanism game, and transliteration to mathematics are done by the students for problem-

solving on the topic of Black principle. The students solve the problem on the topic of heat transfer by mapping mathematics to meaning, physical mechanism game and transliteration to mathematics.

Acknowledgments

The author would like to thank the Faculty of Engineering of University of Nusantara PGRI Kediri, The State University of Malang, and the participating teachers and students of SMAN 3 Malang for making this research possible.

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