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TRENDS IN SCIENCE AND SCIENCE EDUCATION
2015 State University of Medan 12 - 13 December 2015

THE APPLICATION OF CONCEPT MAPPING TO INCREASE THE MATHEMATICS STUDENT ACHIEVEMENT IN STOICHOMETRY

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Abstract

Stoichiometry, a material that seemed easy and simple but has a fairly extensive study. The application of the concept map media will allow students to learn and connect concepts with each other in the learning concept stoichiometry and makes learning more meaningful so students. Results of the study proved that learning with concept maps media effectively used in improving student learning outcomes in program mathematics FMIPA UNIMED in following the general chemistry course-I on learning stoichiometry. The average increase in learning outcomes (gain scores) students are given learning with concept maps media (lesson-1 = 0.67±0.20; lesson-2 = 0.68±0.16; lesson-3 = 0.79±0.15; and the overall lesson = 0.71 ± 0.11) higher than the average increase in learning outcomes (gain scores) students are given learning without media concept map (lesson-1 = 0.50±0.20; lesson-2 = 0.58±0.16; lesson-3 = 0.62±0.14; and the overall lesson = 0.57±0.11).

Keyword : Concept Map, Learning Outcomes, Stoichiometry

A. INTRODUCTION

The success of a learning including learning courses general chemistry-I can be measured on the success of students in following the learning process seen from the results obtained student learning.

In general chemistry-I course is loaded with concepts, from simple concepts to more complex concepts and abstract, it takes a true understanding of the basic concepts that build these concepts. The number of chemicals that are abstract concepts that must be absorbed within relatively limited student makes chemistry is one of the subjects that are difficult for students today.

One of the subjects in the course of general chemistry-I is loaded with the concept is the subject of stoichiometry. Highlights stoichiometry, a material that seemed easy and simple, but has a fairly extensive study, particularly after application in addressing the problems of chemical calculations.

Through the experience of researchers in teaching general chemistry course-I, in particular the subject of stoichiometry found several problems, among others: (1) students still tend to be difficult to master concepts and materials in the course of general chemistry-I especially material stoichiometry; (2) the student is still having difficulty in connecting the concepts of matter are interrelated in a particular subject matter

stoichiometry; and (3) lack of motivation or effort to learn students in following the general chemistry lecture-I, which can be seen from the tasks given faculty is still not done well and still letting themselves. Moreover, in answering the questions posed lecturer during lectures students still tend to be quiet and less active.

One way to do so that the student can easily grasp the concepts studied chemistry is to apply the concept map media. Kopec, Wood & Brody in Asan (2007), revealed that in science education, a concept map has been widely used in a variety of learning. This is because the concept maps can help teachers and students in building the knowledge base or to explain a specific topic.

Rezeki, et al, (2011), suggests learning to use media concept maps can enhance students' understanding of 81.82%-93.94. Elvinawati (2011), concluded that the application of constructivism and models of concept maps can enhance the activity and learning outcomes of students in the course of chemical separation. Ismail et al, (2013), reported the results of his research that the application of learning by using concept map on the media material chemical bonds can improve student learning outcomes, ie 80.09% in the first cycle and 85.79% in the second cycle. Research results of Silaban (2013), media concept map is highly effective in improving student achievement in following basic biochemistry courses.

Simatupang and Dewi (2014), said that with the help of the media forum concept as much as 87% of students able to complete the course of inorganic chemistry-I. According to Arifuddin, et al, (2014), an increase in student achievement can be measured by using concept maps media where the results on the experimental class (88.889%) was higher than the control class (21.429%). Research results of Hayaton (2014), concluded that the learning model concept maps can enhance the activity and student learning outcomes. Rezeki, et al, (2015), stated that the study using concept maps can enhance student achievement of 41.67% in the first cycle to 77.78% in the second cycle.

Concept Learning

Psychologically, learning is a process of change is a change in behavior as a result of interaction with the environment in meeting their needs (Slameto, 2010). The new paradigm in the world of adult education is to create meaningful learning process, understanding learning more emphasis on the notion of learning according to the experts or expert's constructivism. According to experts constructivist in Pribadi (2009), defines learn the meaning of the event or experience that is experienced by individuals. Learning event will take place more effective if the students in direct contact with the object being

studied and in the neighborhood. Education should be seen as a reconstruction process that lasts continuously experience. Students construct new knowledge through events experienced at any time. Giving meaning to the knowledge acquired through the accumulation of meaning to events experienced.

According to the theory of constructivism in Sardiman (2009), learning is defined as an active process of students to reconstruct meaning, something whether it is text, dialogue, physical experience and others. While in Trianto (2011), expert's constructivists assume that the only tool available for someone to know something was senses. Someone interact with objects and surroundings to see, hear, smell, touch, and taste. It appeared that the more knowledge refers to one's experience of the world than the world itself

Learning Outcomes

Nasution (2009) explains that the main purpose of learning is to learn what it is useful at a later date, which helps a person to be able to learn continuously with an easier way. Dick and Reiser was quoted as saying by Nasution (2009), said that the learning outcomes are the abilities of the students as a learning activity.

According Sudjana (2009), the learning outcomes are the abilities of the students after receiving their learning experiences. While Reigeluth Keller was quoted as saying in Uno (2009), states that the learning outcomes are all effects that can be used as an indicator of the value of the use of a method under different conditions. This effect can be deliberately designed effects, because it is the result of learning is the desired effect and can also be tangible effects as a result of the use of certain teaching methods. Further according Sardiman (2009), characteristic of meaningful learning outcomes is durable, genuine and authentic. Learning outcomes achieved should always bring comprehension or understanding of the reaction or answer that can be understood and accepted by the mind.

Media Map Concept

Concept maps or concept mapping is props to show relationships between concepts. Relationships between concepts can be specified in the form of statements. Dahar (2011), suggests that the concept maps are used to express meaningful relationships between concepts in the form of propositions. Propositions are two or more concepts linked by words in a semantic unit. In its simplest form, a concept map consists of two concepts that are linked by a connecting word to form a proposition.

Martin in Trianto (2011), explains that the concept map is a graphical illustration of concrete that indicates how a single concept linked to other concepts in the same

category. Asan (2007), suggests that the concept map is a representation of some of the concepts and the relationships between the structures of the knowledge possessed by someone. Novak (2010), states that the concept maps can help students learn how to learn better and also helps in absorbing knowledge and interpret creativity in all fields of science. Situmorang, et al, (2000), in Jati, et al, (2015), reported that media education is a concept map that can show systematic science concepts.

According Akeju, et al, (2012), the media map concepts contribute to improving student learning outcomes of study fields of physics. Research results Sakiyo and Waziri (2015), reported that students were taught biology concept of biological materials using concept mapping method to realize a better learning outcomes than students taught by lecture method.

Concept map-making is done by making a visual presentation or a diagram of how important ideas or a specific topic linked to one another. Posner and Rudnitsky in Trianto (2011), wrote that the concept maps like a road map, but the map concepts paying attention to the relationship between ideas, not the relationship between spot. To create a concept map, students are trained to identify key ideas related to a topic and develop these ideas in a logical pattern. Sometimes it is a hierarchical concept maps, concept maps sometimes it focuses on the causal relationship.

B. RESEARCH METHODOLOGY

This study was conducted in April-September 2015 in the Department of Mathematics UNIMED Odd Semester TA 2015-2016, which is located at the Williem Iskandar, Psr. V. Medan. The variables to be measured in this study include independent variables and the dependent variable.. The independent variable in this study is learning by using media without the media concept maps and concept maps.. As for the dependent variable which is the result of learning.

This study uses quasi-experiments conducted on two groups of samples is separated. One group of samples treated with learning directly using media concept maps as experimental class and the others were treated with direct instruction without a media concept maps as control class. The steps to be taken in data collection, among others: (1) preparing the achievement test; (2) determine the sample; (3) prepare a concept map learning media; (4) prepare the lesson plan (RPP); (5) carry out a pretest before treatment; (6) make learning appropriate research design; and (7) execute postest. Achievement test that has been arranged, before used as a data collection tool beforehand validated by a validator experts or lecturers.

Data analysis techniques that will be performed include: (1) tabulate the data pretest and posttest; (2) determine the gain normalized to determine the increase in student learning outcomes; (3) executing gain data normality test scores using the Kolmogorov-Smirnov approach; (4) conduct homogeneity test to determine whether the data comes from the same population (homogeneous) approach Levene's Test; (5) to test hypotheses to determine the effectiveness of the media in enhancing the concept maps student results than direct learning without media concept maps with Independet Sample T-Test approach.

C. RESULT AND DISCUSSION

1. Descriptions of Student Learning Outcomes at the First Lesson

The effectiveness of learning using the learning directly using media than learning concept maps directly without the media map concept seen from the increase in the results of the pretest and posttest scores of students based on the data gain (gain score normalized).

Results of the final evaluation of the first phase and the analysis performed with SPSS version 16 can be briefly summarized in Table 1 below.

Table 1. Improvement of Learning Outcomes Students Final Evaluation Results of the First Phase (Figures in Table are Average and Standard Deviation Score)

Indicator to be achieved	Variable	Final Evaluation First	
		Media Map Concept	Without Media Map Concept
Improvement of Learning Outcomes	Pre-test.1	3.11 ± 1.37	2.98 ± 1.75
	Post-test.1	7.71 ± 1.43	6.51 ± 1.58
	Gain Scores.1	0.67 ± 0.20	0.50 ± 0.20

Based on Table 1 above, it can be explained that the average and standard deviation score of learning outcome (gain scores) experimental class students were treated by using the media concept map at the first lesson (0.67 ± 0.20) was higher than the increase grade student results given control treatment without media concept maps (0.50 ± 0.20).

Results of the data analysis of the gain scores (improvement of learning outcomes), to test the data for normality using the Kolmogorov-Smirnov test showed that the data experimental class students gain scores had normal distribution of data distribution (Z = 0.684; Sig. = 0.737> 0.05), while test data normality using the Kolmogorov-Smirnov test showed that the data gain control class student scores had normal distribution of data distribution (Z = 0.561; Sig. = 0.912> 0.05). Levene's Test

results show data variation gain scores between the experimental class and control class in the otherwise homogeneous population (F = 0.994; Sig. = 0.322> 0.05).

To test the significance of media effectiveness compared with no media concept map concept map in improving student learning outcomes Independet Samples were analyzed by using T-Test on the data gain score of the two groups of students. Results of analysis using SPSS version 16 obtained value with the value t = 3.798 Sig. 0.000 <0.05. Based on the analysis, it can be concluded that learning with concept maps media more effectively used in improving student learning outcomes at the first lesson than learning without media concept map. This is evident from the increase in student learning outcomes given the experimental class learning with media concept map at the first meeting (0.67 ± 0.20) was higher than the increase in learning outcomes (gain scores) control class students who were learning without media concept maps (0.50 ± 0.20).

2. Descriptions of Student Learning Outcomes at the Second Lesson

Results of the final evaluation stage (lesson) second and analyzes performed with SPSS version 16, can be briefly summarized in Table 2.

Table 2. Improvement of Learning Outcomes Students Final Evaluation Results of the Second Phase (Figures in Table are Average and Standard Deviation Score)

Indicator to be achieved	Variable	Final Evaluation Second	
		Media Map Concept	Without Media Map Concept
Improvement of Learning Outcomes	Pre-test.2	3.17 ± 1.27	2.76 ± 1.18
	Post-test.2	7.83 ± 1.07	6.98 ± 1.19
	Gain Scores.2	0.68 ± 0.16	0.58 ± 0.16

Based on Table 2 above, it can be explained that the average and standard deviation score of learning outcome (gain scores) experimental class students were treated by using the media concept map at the second lesson (0.68 ± 0.16) was higher than the increase grade student results given control treatment without media concept maps (0.58 ± 0.16).

Results of the data analysis of the gain scores (improvement of learning outcomes), to test the data for normality using the Kolmogorov-Smirnov test showed that the data experimental class students gain scores had normal distribution of data distribution (Z = 0.744; Sig. = 0.637> 0.05), while test data normality using the Kolmogorov-Smirnov test showed that the data gain control class student scores had normal distribution of data distribution (Z = 0.659; Sig. = 0.7782> 0.05). Levene's Test

results show data variation gain scores between the experimental class and control class in the otherwise homogeneous population (F = 0.040; Sig. = 0.842 > 0.05).

To test the significance of media effectiveness compared with no media concept map concept map in improving student learning outcomes Independet Samples were analyzed by using T-Test on the data gain score of the two groups of students. Results of analysis using SPSS version 16 obtained value with the value t = 3.798 Sig. 0.000 <0.05. Based on the analysis, it can be concluded that learning with concept maps media more effectively used in improving student learning outcomes at the second lesson than learning without media concept map. This is evident from the increase in student learning outcomes given the experimental class learning with media concept map at the second lesson (0.68 ± 0.16) was higher than the increase in learning outcomes (gain scores) control class students who were learning without media concept maps (0.58 ± 0.16).

3. Descriptions of Student Learning Outcomes at the Third Lesson

Results of the final evaluation stage (lesson) third and analyzes performed with SPSS version 16, can be briefly summarized in Table 3.

Table 3. Improvement of Learning Outcomes Students Final Evaluation Results of the Third Phase (Figures in Table are Average and Standard Deviation Score)

Indicator to be achieved	Variable	Final Evaluation Third	
		Media Map Concept	Without Media Map Concept
Improvement of Learning Outcomes	Pre-test.3	3.86 ± 1.09	3.46 ± 1.12
	Post-test.3	8.71 ± 0.99	7.51 ± 1.05
	Gain Scores.3	0.79 ± 0.15	0.62 ± 0.14

Based on Table 3 above, it can be explained that the average and standard deviation score of learning outcome (gain scores) experimental class students were treated by using the media concept map at the third lesson (0.79 ± 0.15) was higher than the increase grade student results given control treatment without media concept maps (0.62 ± 0.14)

Results of the data analysis of the gain scores (improvement of learning outcomes), to test the data for normality using the Kolmogorov-Smirnov test showed that the data experimental class students gain scores had normal distribution of data distribution (Z = 0.819; Sig. = 0.513 > 0.05), while test data normality using the Kolmogorov-Smirnov test showed that the data gain control class student scores had

normal distribution of data distribution (Z = 0.811; Sig. = 0.527 > 0.05). Levene's Test results show data variation gain scores between the experimental class and control class in the otherwise homogeneous population (F = 0.042; Sig. = 0.517 > 0.05).

To test the significance of media effectiveness compared with no media concept map concept map in improving student learning outcomes Independet Samples were analyzed by using T-Test on the data gain score of the two groups of students. Results of analysis using SPSS version 16 obtained value with the value t = 5.025 Sig. 0.000 <0.05. Based on the analysis, it can be concluded that learning with concept maps media more effectively used in improving student learning outcomes at the third lesson than learning without media concept map. This is evident from the increase in student learning outcomes given the experimental class learning with media concept map at the second lesson (0.79 ± 0.15) was higher than the increase in learning outcomes (gain scores) control class students who were learning without media concept maps (0.62 ± 0.14).

4. Description Overall Student Learning Outcomes

The data was also analyzed student results overall than 3 (three) times the face-to-face made pretest and posttest both data and analysis of student learning outcome (gain scores).

Table 4. Improvement Total of Learning Outcomes Students (Figures in Table are Average and Standard Deviation Score)

Indicator to be achieved	Variabel	Total Evaluation	
		Media Map Concept	Without Media Map Concept
Improvement of Learning Outcomes	Total Pre-test	10.14 ± 2.44	9.20 ± 2.42
	Total Post-test	24.26 ± 2.13	21.00 ± 2.59
	Total Gain Scores	0.71 ± 0.11	0.57 ± 0.11

Based on Table 4 above, can be explained that the average and standard deviation of the total score improvement of learning outcomes (gain scores) experimental class students were treated by using the media concept maps for three times face-to-face or meeting (0.71 ± 0.11) higher than the increase of learning outcomes (gain scores) control classes students are given treatment without media concept maps (0.57 ± 0.11)

Results of the data analysis of the gain scores (improvement of learning outcomes), to test the data for normality using the Kolmogorov-Smirnov test showed that the data experimental class students gain scores had normal distribution of data distribution (Z = 0.505; Sig. = 0.961 > 0.05), while test data normality using the Kolmogorov-Smirnov test showed that the data gain control class student scores had

normal distribution of data distribution (Z = 0.789; Sig. = 0.562 > 0.05). Levene's Test results show data variation gain scores between the experimental class and control class in the otherwise homogeneous population (F = 0.558; Sig. = 0.457 > 0.05).

To test the significance of media effectiveness compared with no media concept map concept map in improving student learning outcomes in total during the three meetings also Independet Samples were analyzed by using T-Test on the data gain scores. The analysis results obtained t = 5.652 with Sig. 0.000 <0.05. Based on the analysis, it can be concluded that learning with concept maps media more effectively used in improving student learning outcomes in total for the three meetings than learning without media concept map. This is evident from the increase in learning outcomes (gain scores) were given the experimental class students learning with media concept map of the whole meeting (0.71 ± 0.11) was higher than the increase in learning outcomes (gain scores) control class students who were learning without media concept maps (0.57 ± 0.11).

D. DISCUSSION

The findings of the study, showed that an increase in student results in learning Mathematics Prodi stoichiometry of the Course General Chemistry-I were given direct instruction using the media concept map is higher than the increase in student results are given directly without media learning concept maps. This is evident from the average increase in learning outcomes (gain scores) of students in any face-to-face or lesson held.

The first lesson, the average gain score (improvement of learning outcomes) students who were learning langsunng media concept map (0.67 ± 0.20) was higher than students who were given direct instruction without a media concept maps (0.50 ± 0.20). The second lesson, the average gain scores (improvement of learning outcomes) Students are given hands-on learning with media concept map (0.68 ± 0.16) was higher than students who were given direct instruction without a media concept maps (0.58 ± 0, 16). At the third lesson, the average gain scores (improvement of learning outcomes) Students are given hands-on learning with media concept map (0.79 ± 0.15) was higher than students who were given direct instruction without a media concept maps (0.62 ± 0.14). Similarly, from the overall analysis of the three meetings the average gain scores (improvement of learning outcomes) Students are given hands-on learning with media concept map (0.71 ± 0.11) was also higher than the students who were given direct instruction without media map concept (0.57 ± 0.11). This also indicates that learning is more effective media concept maps are used in improving student learning outcomes than learning without media map concept.

The effectiveness of learning with media than without media concept map concept map is also evident from the results of testing the hypothesis by engineering Independet Sample T-Test. First lesson of the obtained value with the value t = 3.798 Sig. 0.000 <0.05. Second lesson of the obtained value with the value t = 2.680 Sig. 0.009 <0.05. At the third lesson of the obtained value with the value t = 5.025 Sig. 0.000 <0.05. For a total of three lessons obtained t = 5.652 with Sig. 0.000 <0.05. Based on the results of hypothesis testing that has been done, we can conclude that learning is more effective media concept maps are used in improving student learning outcomes than learning without media concept maps in learning stoichiometry of the General Chemistry-I Course.

E. CONCLUSIONS

1. Learning with concept maps media effectively used in improving student learning outcomes and interest in mathematics study program Faculty UNIMED in following the general chemistry-I course on learning stoichiometry.
2. The average increase in learning outcomes (gain scores) students are given learning with concept maps media (lesson-1 = 0.67 ± 0.20; lesson -2 = 0.68 ± 0.16; lesson -3 = 0.79 ± 0.15; and the whole assembly = 0.71 ± 0.11) was higher than the average increase in student results are given learning without media concept map (meeting-1 = 0.50 ± 0.20; meeting 2 = 0.58 ± 0.16; and meeting 3 = 0.62 ± 0.14; and overall lesson = 0.57 ± 0.11).

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