CE - 3

THE CORRELATION OF METACOGNITIVE KNOWLEDGE AND THE STUDENTS ACHIEVEMENT IN CHEMISTRY THROUGH TPS MODEL ON THE CONCEPT PROPERTIES OF COLLIGATIVE SOLUTION

Hetty Hortentie Langkudi

Program studi pendidikan kimia fmipa unima tondano
*hettylangkudi@yahoo.com

Abstract

This study aimed to determine the correlation of metacognitive knowledge and students achievement after treated the metacognitive knowledge through Think-Pair-Share (TPS) learning model on the concept properties of colligative solution. Research design used is one group pre-test-post test design. A group of 30 students of senior high school were taken as sample and they were given a set of problem consist of declarative knowledge, procedural knowledge and conditional knowledge. Data of metacognitive knowledge and student achievement were symbolized by X and Y respectively, and the relationship between X and Y were observe by correlation and regression techniques. The finding of the research imply that there is a significant correlation between metacognitive knowledge and student achievement, indicate by r value namely 0.88 higher than r-theoretic 0,37 on the level of significance 5 %. The TPS model is considered as a model that makes the teaching-learning more fun for the students so that they learnt more relaxed. It is concluded that the correlation between metacognitive knowledge which is consist of declarative knowledge, procedural knowledge and conditional knowledge, and the student achievement is significant.

Key words: student achievement, metacognitive knowledge, Think-Pair-Share learning model.

INTRODUCTION

One of the chemistry textbook written "this century is science century, our world is the world of Chemistry ". This sentence certainly want to motivate readers, the teachers and the students to be interested in studying chemistry. Recently people often used the word chemistry to express the harmony fusion between one characteristic to the other one. Chemistry application in everyday life, in technology and industry is also very much to be specified. In KTSP version, chemistry as a subject has been organized among others by Content Standard (SI) and the Student Competency Standards (SKL), but in fact, chemistry in the students' point of view is considered to be a difficult, boring, uninteresting subject, and the result of student achievement in daily tests, midterms, and final exams have not been satisfactorily.

Critics of the process and learning achievement of chemistry in Senior High School focused on teaching and learning dominated by the teacher, so teaching seemed like a lecturing contains knowledge (facts, concepts, principles, law, theories, and procedures) transmitted from the teacher without stimulating the student to think.

It is important to the students understanding their way of thinking, "thinking about your thinking" that is known as metacognition (Burke 2010).

Burke, said "in recent decades, cognitive psychologists have documented a phenomenon of vital importance for everyone interested in education namely metacognition. Cognition is important, but metacognition may help students integrate their facts and apply them to solve problem in the real world". Metacognition can be defined as above or beyond one's cognitive thinking.

Chemistry, as a subject, is concerned with the properties and reactions of substances. Substances are often understood in terms of aggregations of particles, and the nature of the bonding between those particles is used to explain many of the chemical and the physical properties of the substances including such aspect as whether the substance is a solid, liquid or gas at a given tempereture and pressure.(Nahum,cs,2004)

One of the chemistry concept that considered difficult for the students is properties of colligative solution which is devide into electrolyte and non-electrolyte properties. Beside, each of the properties consist of four different concepts namely lowering the vapor pressure, boiling point elevation, freezing point depression, and osmosis. All of these things involved the concept of chemistry, physics, mathematics and biology. For example in biology system osmosis plays a very important role in living-system.The membranes of red blood cells are semipermeable. Placing a red blood cell into a solution that is hypertonic relative to the intracellular solution causes water to move into the cell this may cause the cell rupture, a process call hemolisis.

According to Harry Firman (2007), Studies in chemistry involves three dimensions , namely dimensional of macroscopic reasoning (relating to what is observed) , symbolic dimensions (symbols, formulas , equations) and sub - microscopic dimensions (atoms , molecules , ions , molecular structure) . Think in three dimensions is a demand chemical disciplines that distinguishes it from other disciplines . But at the same time , work to move between the three dimensions of this chemical is often seen as the cause and the emergence of the notion that the chemical is difficult disciplines studied. Related to this dimensions it is important to the teacher providing models or strategies in order the teaching learning to be successfully. In addition, sometimes the the teacher deny the differences among students.Teacher needs to undertstand how students construct their own meaning, how their style, and what beyond the students' answer. In other hand, teacher must involved the student metacognitive.

Green (Miranda, 2010) stated that metacognitive skills can be developed by cooperative teaching strategy since cooperative teaching involved students in communication that mediate their learning. Alternatives should be taken by the teacher to make teaching learning activities more fun for the students namely by using cooperative learning model such as Think-Pair-Share (TPS). TPS model arranged the students to think individually and then pairing to solve the problem, and finally share amongs them.

Statement of the problem of this research was how bigger is the correlation of metacognitive knowledge which is consits of declarative knowledge, procedural knowledge and conditional knowledge respectively with students achievement of grade twelve IPA of SMA Negeri 3Manado on properties of colligative solution concept through TPS model ?

Goals of this study was to determine the correlation of metacognitive knowledge with students learning achievement on properties of colligative solution concept through the TPS model in class XX IPA 1 SMA Negeri 3 Manado.

The benefits of this research are:1. To provide information about students metacognitive knowledge. This information is important for the teaching staff and school as well so they can manage the individual diffrences in the class and in teaching learning activities through TPS Model

2. To practice students metacognitive ability in chemistry learning. This was also one of the effort to improve teaching learning activities.

RESEARCH METHOD

Method used in this research is Pre-Experimetal One group Pre-test Posttest design. This research was conducted at a state school namely SMA Negeri 3 Manadoon the odd semester of 2014/2015 academic year. Students of grade twelve (XII IPA-1) 30 students were taken as sample.

With regard to TPS model, at Think stage , students are asked to solve chemistry problems namely problems about properties of colligative solution, individually . In the Pair stage , students pair up with their closest friends and discuss their answers . At Share stage, students presented the results of the discussion ,and another student responded .This TPS model is applied in five meetings. Posstest on learning outcomes and metacognitive knowledge held at the sixth meeting. Hypothesis to be tested is null hypothesis : there is not a very strong relationship and significant correlation between metacognitive knowledge with student learning outcomes through learning model TPS on the concept properties of the colligative solution.The hypothesis test using Pearson product moment correlation, regression test to determine the relationship between the independent variables and the dependent variable.

Techniques of data collection is by administering the test. This test is used to determine students learning outcomes and students metacognitive knowledge. Furthermore sought correlation between metacognitive knowledge and student achievement. Data were analyzed descriptively. Data devided into two parts, data of cognitive problem and data of metacognitive knowledge. Student learning outcomes is calculated by dividing the maximum scores with the score multiplied by one hundred. Score obtained and compared to the minimum completeness criteria or KKM namely 75.

Questions about student metacognitive knowledge are assessed using rubric assessment as shown on the table below.

Table 1. The Comparison of Declarative Knowledge, Procedural Knowledge and Conditional Knowledge(Rompayom P, 2010)

Score	Description		
	Declarative knowledge	**Procedural knowledge**	**Conditional knowledge**
0	Not associated with the task . Students can not describe anything related tasks .	Students can not described strategy that they have used in solving problem and how they solve the problem.	Students can not explain when and why to use strategies to solve problems
1	Students write a statement not specifically related to chemistry but they do not connect with the statement	Students look to understand the purpose tasks , but they do not make specific statements that are not associated or related to the information given and questions	Student enrolled strategies used in solving the problem, but do not explain when or why they do so, or why to use these strategies or non specific statement.
2		Students clearly define their strategies .	Students know clearly when and why to use

	Students clearly summarize what related tasks .	Students are strongly thinking about the implications of giving information with questions .	strategies to solve problems . Overview of strategies they associated with a real provision of information and questions.

RESULT AND DISCUSSION

The research data was obtained from a 30 students as sample of class XII IPA 1 SMA Negeri 3 Manado on odd semester academic year 2014/2015, before and after treatment of cognitive knowledge through TPS model then carried out the analysis of learning outcome in the form of a combination of cognitive and metacognitive knowledge. Student metacognitive knowledge consist of declarative, procedural and conditional knowledge.

Declarative knowledge refers to the knowledge that students have about the information or the resources needed to carry out the tasks given such knowledge of : (a) the purpose of the task (What is the purpose in performing a given task ?) ; (b) on the demands of the task (Resources and What steps are needed to solve the problem) ; (c) the nature of the task (what tasks are related to ?) .

Procedural knowledge refers to the knowledge or belief about themselves on a given task . Perception of one's individual capacity on how to do something .

Conditional Knowledge Based on the knowledge of when and why to use strategies to solve the problem . Knowledge of the situation in which the students can use the subject -specific skills , techniques , and methods. According to Fisher (1998) one of the ways to train students' metacognitive awareness is to make clear the flow of thought and understanding of students in learning , for example by asking " knowledge that we use today is ... " , " lesson today is about .. . " , " knowledge that we get today is ... " which involves declarative knowledge , procedural , and conditional .

Data of Metacognitive Knowledge and Students' Learning Outcomes shown respectively in tables below:

Tabel 2 Data of Metacognitive Knowledge

Statistic	Metacognitif knowledge
N	30
Total Value	969
Average(x)	32,30
Standard deviation(s)	4,60
Variance (s^2)	2118

Tabel 3 Data of Students' Learning Outcomes

Statistic	Metacognitive Knowledge
N	30
Total Value,$\sum$	2645,56
Average (x)	88,19
Standard deviation(s)	10,95
Variance (s^2)	120,01

Table 4.Comparison of Pre-test and Post-test

Statistic	Class XII IPA-1	
	Pre-test	Post-test
Total Value,∑	2034.44	264.56
Average (x)	67.81	88.19

The cognitive problem and metacognitive can be seen in the following example:
If we dissolve 9 grams of simple sugar ($C_6H_{12}O_6$) in 500 grams of water , what is the molality of glucose in the solution ? (Cognitive problem)
By using of formulae the answer is 0,1 molal.
Next questions are metacognitive:

1.Declarative knowledge:
What knowledge is related to answer the above questions ?
- Related knowledge that is needed to answer the question
- The concept of the mole
- molality
- The formulae for calculating the mole
- The formulae to calculate the molality

2. Procedural Knowledge
How do you get the answer?
Answer: molality is the number of moles of solute per kilogram of solvent . Because the mole is not known then sought in advance the number of moles of $C_6H_{12}O_6$.
- Using formulae that is moles = g / (M_r)
- Counting the relative mass , M_r. Of $C_6H_{12}O_6$ namely:
- M_r = (6 x A_rC) + (12 x A_r H) + (6 x A_r O)
  =(6x12) + (12x1) + (16x6) = 180

So mol glucose = g / (Mr) = (9 g) / (180)=
calculate molality
m = m / Mr x 1.000 / p = (9 g) / (180) x 1000 / 500g = 0.1 molal
So , molality of glucose is 0.1 molal

3. Conditional knowledge
Explain why do you use the above way for the answers ! (Conditional knowledge)
Answer :
Due to determine M_r of solute in this case is $C_6H_{12}O_6$ in advance we can calculate the amount of mole concentration and then calculate the amount of glucose molar concentration

Correlation test.

Metacognitive problem consist of 18 items test developed from 6 coligative solution problems as posttest. It was found that r observation is 0,875 as value of correlation coeffient, means that there are strong relationship between metacognitive and student learning outcomes through TPS model compare to r table namely 0,374.(0,875 > 0,375)

According to Green (1992) the skill of metacognitive influenced by the strategy using in teaching and learning activity. So that metacognitive ability can be developed by cooperative model such as Think-Pair-Share (TPS). Chikmiyah (2012) said that there is strong relationship between metacognitive knowledge and student learning outcomes through TPS model. This model with it steps can encourage student to practice their ability to think individually, and then

they will find their friend to be pair and discussed the problem or question. Finally they will share their answer clasically. TPS model can prevent students from rote learning . With TPS model students learn from each other and seek to exchange ideas in the group.TPS model increased self-confidence of students because all students have the opportunity to participate in class.
Problems in learning chemistry is a student who does not understand the concept will try to memorize the way of solving problem.

According to Novak (1980), rote learning occured when new knowledge is not related to relevant concepts already in the students' cognitive structure, or when no attempt is made to assimilate new knowledge into existing relevant concepts. By TPS model, teacher can observe their students diffrences or the students way of answer and their students way of thinking. This research used essay test to get the correlation between cognitive problem and metacognitive knowledge. Essay test allowed student to used their style individually and groups in make explanation or answer the question and solve the problems.

Regression test to determine the relationship of the variables. Based on the analysis, it was found that R square is 0.77; t=9.61, a=20.8; and b (beta) = 2.09. The value of t table with df 29 is 2.045, compare to t observation 9.61 is higher then t table. Therefore can be concluded that metacognitive knowledge relationship with the student learning outcomes is significant. The magnitude of the effect can be seen from the R square of 0.77 which means the influence of metacognitive knowledge on student learning through cooperative learning model TPS in concept of coligative solution properties by 77%. For metacognitive knowledge the average is 32.30 or 90% and the average was 88.25. This study proves that metacognitive knowledge of student and student learning outcomes are very good.
The motivation of students are increased through TPS model because they can learn more satisfactorilly. The result of related study according to research conducted by Chikmiyah (2012) ,that there was a strong correlation between metacognitive knowledge and student achievement.
According to Flavel (Livingston,1977), metacognitive process is very condusive to guide the students constructing their knowledge. If there is question: is cognitive and metacognitive related each other? What is the difference between a cognitive and a metacognitive strategy?Flavell himself acknowledges that metacognitive knowledge may not be different from cognitive knowledge. The distinction lies in how the information is used. To be understand that metacognitive and cognitive strategies may overlap in that the same strategy, such as questioning. Questioning as teaching strategy could be regarded as either a cognitive or a metacognitive strategy depending on what the purpose for using that strategy may be. For example, the teacher or students may use a self-questioning strategy while reading as a means of obtaining knowledge (cognitive), or as a way of monitoring what you have read (metacognitive). Because cognitive and metacognitive strategies are closely intertwined and dependent upon each other, any attempt to examine one without acknowledging the other would not provide an adequate picture. In addition according to Livingston (1977), metacognition refers to higher order thinking which involves active control over the cognitive processes engaged in learning.

CONCLUSION AND SUGGESTION

Conclusion

1. The correlation of metacognitive knowledge and student achievement in coligative solution properties concept are strong and significant
2. The value of metacognitive knowledge with student learning outcomes in properties of coligative solution concept through TPS model is 77%.

Suggestion

1. The results of this study can be used by teachers to develop students' metacognitive knowledge to other chemical concepts .
2. Students should be guided to identify their metacognitive knowledge in order they can more aware of their thought processes.
3. Metacognitive knowledge through TPS model can be use as alternative in teaching learning activity in other topics of chemistry.

REFERENCES

Burke, Kay.2009. How to Assess Authentic Learning, Fifth edition, Corwin a Sage Company2445 Teller Road Thousand Oaks California

Choirotul Chikmiyah and Bambang Sugiarto, 2012. Relationship between Metacognitive Knowledge and Student Learning outcomes Through Cooperative Model Type Think-Pair-Share on Buffer Solution. Unesa Journal of Chemical Education Vol.2 No.3

Firman, Harry. 2007. Pendidikan Kimia, dalam Ilmu dan Aplikasi Pendidikan, editor Mohammad Ali. Bandung: Imperial Bhakti Utama.

Fisher, R. 1998. Thinking About Thinking: Developing Metacognition in Children. (http://www.makepuppet.org/workbook/Teaching%20thinking%20and%20creativity_metacogntion_05122010.pdf) diakses pada tanggal 30 Maret 2014 jam 13.00 WITA di Tondano.

Livingston, Jennifer. 1977. Metacognition An Overview(http://gse.buffalo.edu/fas/shuell/cep564/metacog.htm. diakses pada tanggal 130 Maret 2014.

Miranda, Y. 2010. Pembelajaran Metakognisi Dalam Srategi Kooperatif Think-Pair-Share Dan Think-Pair-Share+Metakognisi Terhadap Kemampuan Metakognisi Siswa Pada Biologi Di SMA Negeri Palangkaraya. Palangkaraya: FKIP Universitas Palangkaraya. ((http://www.ilmupendidikan.net/2010/03/16/pembelajaran-metakognitif.php) diakses pada tanggal 30 Maret 2014 jam 13.30 WITA di Tondano

Nahum Tami Levy, Avi Hofstein, Rachel Mamlok Naaman dan Ziva Bar-Dov. "Can Final Examinations Amplify Students' Misconceptions in Chemistry?" Chemistry Education: Research and Practice, 2004. Vol. 5, No.3. pp.301-325. http://www.uoi.gr/cerp/2004_october/pdf/ogHolfstein.pdf. Diakses 20 Juni 2012.

Novak Josepk. D. 1980. Meaningful Reception Learning as a Basis for Rational Thinking, AETS Yearbook, Clearinghouse for Science Mathematics, and Environmental Education, The Ohio State University, Colombus, Ohio 43212.

Rompayom, and Patcharee, 2010. The Development of Metacognitive Inventory to Measure Students' Metacognitive Knowledge Related to Chemical Bonding Conceptions. Bangkok: Srinakharinwirot University. (http://selectscore.com/fullpaper/221.pdf.) diakses pada tanggal 30 maret 2014 jam 14.00 WITA di Tondano.

Woolfolk, Anita, 2009. Educational Psychology: Active Learning edition. Boston Pearson Education Inc.