INTERNATIONAL JOINT CONFERENCE ON SCIENCE AND TECHNOLOGY 2017

SCIENCE, TECHNOLOGY, INNOVATION, AND CULTURE FOR SUSTAINABLE DEVELOPMENT: CHALLENGE FOR GREEN INDUSTRY

CERTIFICATE OF APPRECIATION

No. : 09.002/IJCST/2017

is awarded to:

Utiya Azizah

(Presenter)

in recognition of valuable contributions.

Nusa Dua Bali, September 28, 2017

Conference Chair,

Lilik Sudiajeng (Dr. Ir., M.Erg.)

Conference Marks:

The 2nd I-CAN
INTERNATIONAL CONFERENCE ON APPLIED RESEARCH AND INNOVATION

The 2nd ICOSE
International Conference On Science And Engineering

The 2nd ICOMSE
International Conference On Mathematics, Science And Education

The 2nd INCHESS
International Conference On Humanities, Education, And Social Science

The 5th bisstech
Bali International Seminar on Science And Technology

The 2nd ITIS
Information and Communication Technology International Seminar

AYODYA RESORT NUSA DUA BALI, INDONESIA, 27-28 SEPTEMBER 2017

Journal of Physics: Conference Series

PAPER • OPEN ACCESS

Empowerment of Metacognitive Skills through Development of Instructional Materials on the Topic of Hydrolysis and Buffer Solutions

To cite this article: U Azizah and H Nasrudin 2018 *J. Phys.: Conf. Ser.* **953** 012199

View the article online for updates and enhancements.

You may also like

- Teachers as Makers: The Key Provision of Teacher Preparations for STEM Education
Suthida Chamrat
- Ptolemy's experiments on refraction in science class
C Stefanidou, V Psoma and C Skordoulis
- The effectiveness of iCRT Video-based Reflection System on Pre-service Teachers' Micro Teaching Practice Focusing on Meaningful Learning with ICT
K F Ratumbuisang, Y T Wu and H D Surjono

IOP ebooks™

Bringing together innovative digital publishing with leading authors from the global scientific community.

Start exploring the collection–download the first chapter of every title for free.

This content was downloaded from IP address 103.242.125.242 on 12/01/2022 at 12:51

IOP Conf. Series: Journal of Physics: Conf. Series **953** (2018) 012199 doi:10.1088/1742-6596/953/1/012199

Empowerment of Metacognitive Skills through Development of Instructional Materials on the Topic of Hydrolysis and Buffer Solutions

U Azizah, H Nasrudin
Chemistry Department, Universitas Negeri Surabaya, Surabaya**, Indonesia**

utiyaazizah@unesa.ac.id

Abstract. Metacognitive skills are one of the high-level thinking skills that pre-service teachers need in chemistry problem-solving. Metacognitive skills that empowered in learning focuses on how pre-service teachers participate in designing what was to be learned, monitor the progress of learning outcomes, and assess what has been learned in solving problems. The purpose of this research was (1) describe how pre-service teachers empowering metacognitive skills using developed instructional materials, and (2) describe the pre-service teacher's response to the learning process. The research involved 22 pre-service teachers in Chemistry Education Program Universitas Negeri Surabaya, Indonesia. The design of this research was a pre-experimental research with One Group Pretest-Posttest Design. The data of the research was analyzed by quantitative descriptive. The result of the research that: (1) performance of metacognitive skills pre-service teachers have high and very high criteria in learning chemistry on each indicator includes goal setting, identify the known knowledge, determining the learning strategies, monitoring the relevance of knowledge which has been owned with learning strategies are used, monitoring the achievement of the goal in the making conclusions, and evaluating the process and outcomes of thinking, and (2) most of the pre-service teachers are willing to join to this teaching-learning activity.

1. Introduction

As part of the education policy reforms, the Ministry of Education and Culture of Indonesian has strengthened the importance of metacognitive thinking skills through the shift to the 2013 curriculum to increase the quality of education [1]. To support the empowerment of metacognitive skills in the curriculum, teachers have the responsibility to be proactive in planning learning activities which involve metacognitive skills. The integration of metacognitive skills in learning chemistry requires that teachers encourage students to explicitly carry out previously designed learning activities, evaluate their understanding, decide on their learning, and establish the ease of learning that can improve learning outcomes [2; 3].

However, teachers are not ready to apply metacognitive skills and do not train their students to use metacognitive skills in solving problems. The statement is supported by research results which show that science teachers still have weak pedagogical practices [4]. Teachers also pointed out the need for metacognitive skills, but difficulties in empowering metacognitive skills have been found by some previous researchers, among them, metacognitive activity is a mental activity so that it cannot be observed immediately even though it can happen at any time [5], metacognitive skills are not easily taught [6], and students do not spontaneously engage in metacognitive thinking and skills [2]. This

Content from this work may be used under the terms of the Creative Commons Attribution 3.0 licence. Any further distribution of this work must maintain attribution to the author(s) and the title of the work, journal citation and DOI.
Published under licence by IOP Publishing Ltd

means that developing the design of learning activities that empower metacognitive thinking skills is a very important undertaking.

In general, thinking is a cognitive process, which is a mental activity to gain knowledge. Awareness and control over cognitive activity are known as metacognitive knowledge, while one's way of raising awareness of the thinking process is known as metacognitive skills. Metacognitive skills are the control of the thinking process, which refers to the skills of planning, monitoring, and evaluating [7]. Some of these opinions are reinforced by the results of research that metacognitive skills in learning chemistry are needed to solve chemistry problems [8].

Metacognitive skills in chemistry are thinks' about thinking skills in solving chemistry problems. This is in accordance with the opinion that in the learning process there are three teachings about thinking, namely teaching of thinking, teaching for thinking, and teaching about thinking [9]. The teaching of thinking is a learning process directed to the formation of mental skills such as metacognitive skills, teaching for thinking directed at creating a learning environment that can encourage cognitive development, while teaching about thinking is directed at efforts to help students more aware of the process of their thinking.

Some psychologists who study metacognitive skills provide some activities in the planning component, ie plan a task, choose a strategy to use, resources to use, sequence to be followed, write down learning objectives, write relevant information in a coherent manner, and write down steps or procedures for solving problems or doing the task [10]. Further, in the monitoring component, it states that monitoring is a real-time awareness of "how I work," [11] and the core of metacognitive skills is the ability of self-knowledge monitoring [12]. Similarly, the evaluation component of metacognitive skills involves making decisions about the processes and results of thinking/learning [11], and students applying reflective judgment can improve the quality of learning strategies and learning outcomes [13]. Based on some of the opinions and results of the research, the indicators of metacognitive skills applied in this research, including goal setting, identifying known knowledge, determining the learning strategies, monitoring the achievement of the goal in the making conclusions, and evaluating the process and outcomes of thinking.

Pedagogical skills are important components in teacher preparation programs and professional development to ensure teachers can conduct proper teaching and learning activities in the classroom. The pedagogical knowledge of pre-service teachers can not be separated from the content of the learned material known as pedagogical content knowledge [14]. The synergy of these two capabilities leads the pre-service teachers to be able to package the subject matter so that it can be easily understood by the students in the future. The direct experience gained by pre-service teachers will be applied and developed in the field when they become teachers so that they become more creative and innovative in developing their knowledge. Therefore, the existence of students as pre-service teachers is very important and is a key to the quality of learning. Likewise, according to Corebima [15] that empowering metacognitive skills is believed to have great human empowerment potential.

As previously implied, metacognitive skills are an important part of the learning process. This is in line with one of the goals of higher education, which is to transform and develop the students' abilities, including to design what will be done, carry out what is planned, monitor and evaluate what is being and has done so as to be critical, creative, innovative, and independent [16]. The same thing is said by Flavell that a good college should be an ideal place for the development of metacognitive skills [17].

The topic of hydrolysis and the buffer solutions is one of the materials in basic chemistry course which is a compulsory subject for pre-service teachers at FMIPA Universitas Negeri Surabaya. According Sukamto [18] to direct pre-service teachers in understanding a concept and can increase the retention of learning outcomes should be provided instructional materials. In addition, the implementation of instructional materials can empower students' thinking skills in the mastery of chemical concepts [19]. The statement is reinforced by the results of research that the improvement of metacognitive skills of students also increases the mastery of the concept. This means that through the instructional materials and metacognitive skills they possess, the pre-service teachers can construct

knowledge, apply the concepts of chemistry, and deepen the concepts of chemistry so as to produce scientific answers that represent mastery of concepts [20].

2. Methodology of Research

The design of this research was a pre-experimental research with One Group Pretest-Posttest Design [21]. To measure the attainment of metacognitive skills, an initial and final metacognitive skill test was conducted on a number of 22 pre-service teachers at the chemistry department of Universitas Negeri Surabaya. The class was tested to find out the pre-service teachers' initial ability on the mastery of chemistry concepts related to metacognitive skills. Then, the class is taught by used the instructional materials. In the end of the program, the class was tested in a posttest on the mastery of chemistry concept related metacognitive skills and filled out a questionnaire response to the lecture implementation.

The question of metacognitive skills consists of 12 item questions for the topic of the hydrolysis and the buffer solution is arranged based on the indicators of the metacognitive skills are goal setting (P1), identification the known knowledge (P2), determining the learning strategies (P3), monitoring the relevance of knowledge which has been owned with learning strategies are used (M1), monitoring the achievement of the goal in the making conclusions (M2), and evaluating the process and outcomes of thinking (E) [22]. Metacognitive skills are assessed through an answer sheet using four Likert scale points is scored 0 to 3, ranging from no effort (no metacognitive skills) to the most appropriate answer (metacognitive skills). The metacognitive skill scored is changed to a scale of 100, and the value obtained is categorized according to the level of attainment of its metacognitive skills. The levels of achievement and these categories are very high (85 - 100), high (70 - 84), medium (55 - 69), low (40 - 54), and very low (0 - 39). Full criteria of assessed metacognitive skills were listed in **Figure 1**. To determine the improvement of metacognitive skills, N-Gain scored were calculated using the formulas expressed by Hake [23].

Formulation of N-gain according to Hake (2002), that is:

$$(g) = \frac{\%\ actual\ gain}{\%\ potential\ gain} x\ 100 = \frac{\%\ posttestscore - \%\ pretestscore}{100 - \%\ pretestscore}$$

Furthermore, it was descriptively analysed of N-gain using N-gain criterion to determine the category of improvement of pre-service teachers' metacognitive skills, namely: (1) learning outcomes with "high gain" if $\langle g \rangle > 0.7$; (2) learning outcomes with the "medium gain" if $0.3 < (g) \leq 0.7$; and (3) the learning outcome with "low gain" if $\langle g \rangle \leq 0.3$ [23].

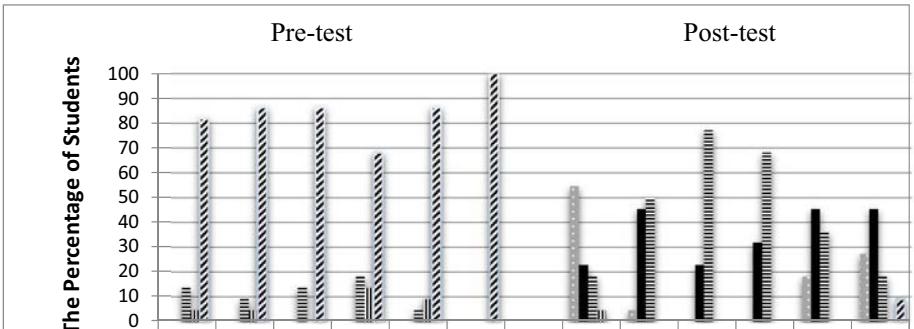
Data on pre-service teachers responses were collected using questionnaires that included questions relating to the implementation of learning with the criteria not good to very good, difficult to very easy, and not interested to very interested, and what pre-service teachers thought after learning by used the instructional materials. This statement is listed in **Table 2**. At the end of the questionnaire, there is an open column to express the impression and message about the learning activities that have been done. Open columns allow pre-service teachers to write messages and impressions in order to improve the quality of learning. Metacognitive skills and response data were analyzed descriptively.

3. Result of Research

The instructional materials that have been developed by researchers aim to empower metacognitive skills in lectures. Three independent experts are required to validate the instructional materials to ensure all metacognitive skills indicators are properly implemented. The purpose of developing the instructional materials is to empower the metacognitive skills of pre-service teachers in constructing the concept of hydrolysis and buffer solution in order to fulfill the pedagogical content knowledge rules. Empowerment of metacognitive skills is obtained through metacognitive skills tests.

The metacognitive skills profiles of pre-service teachers in this study are metacognitive skills that arise in response to questions in the question of metacognitive skills from the topic of hydrolysis and

buffer solutions. The questions chosen in measuring metacognitive skills are questions that require pre-service teachers to doing think process through metacognitive skills indicators.



	P1	P2	P3	M1	M2	E	P1	P2	P3	M1	M2	E
Very High	0.00	0.00	0.00	0.00	0.00	0.00	54.54	4.55	0.00	0.00	18.18	27.27
High	0.00	0.00	0.00	0.00	0.00	0.00	22.73	45.46	22.73	31.82	45.46	45.46
Medium	13.64	9.09	13.64	18.18	4.55	0.00	18.18	50.00	77.27	68.18	36.36	18.18
Low	4.55	4.55	0.00	13.64	9.09	0.00	4.55	0.00	0.00	0.00	0.00	0.00
Very Low	81.81	86.36	86.36	68.18	86.36	100.0	0.00	0.00	0.00	0.00	0.00	9.09

Figure 1. The Profile of Metacognitive Skills in Hydrolysis and Buffer Solution

Based on **Figure 1**, it can be analyzed that the ability of all pre-service teachers in planning problem solving (P1, P2, and P3), implementing problem-solving plans (M1 and M2), and evaluating (E) before the lecture implementation on hydrolysis material and buffer solution is mostly prospective teachers were at low and very low category. This capability increases to medium, high, and very high criteria after instructional materials implementation on all indicators.

The results of this study are also supported by N-Gain results on all metacognitive skill indicators with the "medium" category, whereas for P1 and E indicators with the "high" category as presented in **Table 1**. This means that lecturing activities can improve metacognitive skills indicators.

Table 1. The Average Initial Tests, Final Tests, and N-Gain Each Indicator Metacognitive Skills

Indicators	The Average Initial Tests	The Average Final Tests	N-Gain and Criteria
P1	27.27	87.86	0.83 (High)
P2	24.24	75.76	0.68(Medium)
P3	23.48	70.45	0.61 (Medium)
M1	40.15	71.97	0.53 (Medium)
M2	34.85	80.30	0.70 (Medium)
E	12.12	80.30	0,78 (High)

The attractiveness of the instructional materials implementation in terms of the pre-service teacher's response using responses questionnaire. Most of the pre-service teachers showed a positive response to the implementation of the instructional materials. Most of the pre-service teachers were interested if lectures by empowering metacognitive skills are applied to other materials in basic chemistry courses and applicable to other courses (**Table 2**).

Table 2. Pre-service Teachers' View in Response to The Lectures Implementation

Criteria	% Responses	Categories
The lectures implementation of hydrolysis and buffer solutions that have been followed are good and interesting	86,36	Very high
Easiness in material understanding through the implementation of instructional materials	81,82	High
Ease in practicing metacognitive skills a. Identification the known knowledge through phenomena	72,73	High
b. Goal setting	81,82	High
c. Determining the learning strategies or thinking	77,27	High
d. Monitored the relevance of the known knowledge, goal achievement, learning strategies, and the implementation of strategies	77,27	High
e. Evaluated the relevance of the known knowledge, goal achievement, and learning strategies that have been used	72,73	High
Ease in answering questions in tests after attending lectures	68,18	Medium
Interested in this kind of learning when be applied to other materials in the topic of solution	95,45	Very high
Interested in this kind of learning when be applied to other topics	90,91	Very high

4. Discussions

The findings showed that development of instructional materials on the topic of hydrolysis and buffer solutions was successfully able to improve empowerment of metacognitive skills to the tested pre-service teachers. The empowerment of metacognitive skills in this research is demonstrated by the implementation and attractiveness of instructional materials implemented on the topic of hydrolysis and buffer solutions. The realization of the implementation is also reflected when the pre-service teachers undertake lectures by using the worksheet, starting from planning the problem, implementing the problem plan through visualization with the help of drawing or animation and tracking information through the internet network, and evaluating the results of problem-solving.

The metacognitive skill profiles of planning skills early pre-service teachers were mostly low and very low in all indicators on all topics, and there were some students (4.55% - 13.64%) who already had a fairly high category on the indicators of P1, P2, and P3. The fact that many percentages of pre-service teachers have low and very low categories in all of these indicators is a natural occurrence for students who have never gained concepts of hydrolysis and buffer solutions and have never empowered metacognitive skills. This is in consistent with the findings of some researchers who stated that in general students tend not to activate knowledge that has been known and use a strategy that is less effective [24]. Lin [2] reveals that students are not spontaneously involved in metacognitive skills unless explicitly encouraged to undertake a pre-planned learning activity.

The achievement of metacognitive skills indicators in planning skills with the implementation of instructional materials is showed by the final test result data, that the overall concept tested by the majority of pre-service teachers already have a high category and very high on the indicator P1, and still leaves some pre-service teachers who have enough category on the indicator identify the known knowledge (P2) and determining the learning strategies (P3) and there is still one student with a low category in P1. That's indicating that the majority of pre-service teachers have been able to carry out planning skill activities fairly well. The results of this research reinforce the results of previous research [10] which revealed that goal setting, writing relevant information in a coherent manner, determining learning strategies, and the writing of steps or procedures for solving problems or tasks are activities that can improve the metacognitive skills in planning skills.

This is in accordance with the positive response of the pre-service teachers who state that the lectures of hydrolysis and buffer solutions can assist in understanding the material and practicing

metacognitive skills that include identifying the known knowledge through phenomena and goal setting (**Table 2**). As one of them asserted:

> "The instructional materials have been able to empower metacognitive skills as well as ease in material understanding. Planning skills manifested through the activities of identifying the known knowledge of matter based on phenomena, understanding problems in the form of problem formulation and hypotheses, and being able goal setting."

In the skills of monitoring, for the whole concepts are tested the majority of pre-service teachers have high enough and high categories on indicator M1 and M2, and there are no pre-service teachers who have a low category. This fact reveals that pre-service teachers have the ability to monitor the knowledge have known and learning strategies used in implementing the task completion plan. Based on the results of the completion of their duties, the majority of pre-service teachers have the ability to make conclusions according to goal setting. This is in line with the view that in teaching metacognitive skills, teachers should give students the opportunity to practice self-monitoring and adaptation [25].

In the skills of evaluating, for the whole concepts are tested, the majority of pre-service teachers have a high and very high category on the E indicator, and there are no pre-service teachers who have a low category. This means that the majority of pre-service teachers after learning have been able to improve evaluating skills by evaluating the results of thinking that have been used in solving the problem. The findings of this research are consistent with the view that the evaluation component in metacognitive skills involves making decisions about processes and outcomes in accordance with learning strategies and achievement of learning objectives [11].

The improvement of pre-service teachers' metacognitive skills in this research was expressed by the N-Gain category on each metacognitive skill indicator of the topic of hydrolysis and buffer solution that was in the medium category on indicator P2, P3, M1, and M2, and high category on indicator P1 and E. The fact indicates that instructional materials are effectively applied in the classroom to empower metacognitive skills. For the monitoring indicator of the relevance of knowledge which has owned with learning strategies are used (M1) has the N-Gain with the lowest category with the medium category. These findings indicate that the indicator has a lower average score of the final test among other indicators. Nevertheless, each N-Gain has a high and medium category that has been in accordance with the criteria of effectiveness in this research.

Nevertheless, the lowest response (68.18%) was found in terms of ease of answering questions in the test after attending lectures (**Table 2**). This was consistent with pre-service teacher comments as described below.

> "The lectures implementation of hydrolysis and buffer solution that have been followed were good and interesting, but it was difficult to answer the questions in solving the problem."

In line with this comment, another pre-service teacher also comments as follows.

> "The activity of planning skills, monitoring skills, and evaluation skills have not used to do before, so often forget to be done, for example in setting learning goals and communicating the results of self-evaluation."

Some pre-service teachers also provide suggestions for new features in the student worksheet that is a material summary that can help pre-service teachers understand the material.

> "Material summary is needed in material understanding before answered the questions, so problem-solving can go smoothly."

In addition, student pre-service teachers also suggested the addition of an interesting phenomenon to practice more in solving problems.

5. Conclusions

The result of the research that: (1) performance of metacognitive skills pre-service teachers have high and very high criteria in learning chemistry on each indicator includes goal setting, identify the known knowledge, determining the learning strategies, monitoring the relevance of knowledge which has

been owned with learning strategies are used, monitoring the achievement of the goal in the making conclusions, and evaluating the process and outcomes of thinking, and (2) most of the pre-service teachers are willing to join to this teaching-learning activity.

Acknowledgements
The research reported in this article was supported by Ministry of Research and Technology (Kemenristek)-DIKTI Indonesia through applied product research. The author thanked the first-year pre-service teachers of Chemistry Education program who are directly involved in increased metacognitive skills.

References

[1] Peraturan Menteri Pendidikan dan Kebudayaan Republik Indonesia Nomor 21 Tahun 2016 Tentang Standar Isi Pendidikan Dasar dan Menengah.
[2] Lin, Xiaodong. 2001. *Designing metacognitive activities*. ETR&D, **49**(2), 23–40. ISSN 1042–1629.
[3] Garrett, J. Alman, M. Gardner, S. Pharmd., and Born, C. 2007. "Assessing students' metacognitive skill." *American Journal of Pharmaceutical Education*, **71**(1), 14-16.
[4] World Bank. (2010). *Transforming Indonesia's teaching force* (Volume I: Executive Summary). Jakarta: World Bank Office Jakarta.
[5] Alvarez, M. 2007. *The use of vee diagrams with third graders as a metacognitive tool for learning science concepts*. Retrieved from: http://www.tnstate.edu/library/eresearch/ttl/tlfive.pdf
[6] Fouche, Jaunine. and Lamport, Mark A. 2011. "Do metacognitive strategies improve student achievement in secondary science classrooms*?" Christian Perspectives in Education*, 4(2). The Berkeley Electronic Press.
[7] Hacker, Douglas J., Dunlosky, John, and Graesser, Arthur, C. 2009. *Handbook of metacognition*. New York: Routledge Taylor and Francis.
[8] Rickey, D. and A. Stacy. 2000. "The role of metacognition in learning chemistry." *Journal of Chemical Education,* **77**(7), 915–920
[9] Sanjaya, Wina. 2006. Strategi Pembelajaran Berorientasi Standard Proses Pendidikan. Jakarta: Kencana
[10] Pulmones, Richard. 2007. "Learning chemistry in a metacognitive environment." *The Asia Pacific – Education Researcher*, **16**(2). 165-183. ISSN: 0119-5646.
[11] Woolfolk, Anita. 2009. *Educational psychology: Active learning edition*. Yogyakarta: Pustaka Belajar.
[12] Solso, Robert L., Maclin, Otto H., and Maclin, M. Kimberly. 2008. *Cognitive psychology*. Eight Edition. Boston: Pearson Education, Inc.
[13] Wood, P., and Kardash, C. A. 2002. Critical elements in the design and analysis of studies of epistemology. In B. K. Hofer & P. R. Pintrich (Eds.), *Personal epistemology: The psychology of beliefs about knowledge and knowing*. 231–260. Maswah, NJ: Lawrence Erlbaum
[14] Kind, V. 2009. Pedagogical content knowledge in science education: Potential and Perspectives for progress. Studies in Science Education, **45**(2), 169–204.
[15] Corebima, A.D. 2010. "Berdayakan keterampilan berpikir selama pembelajaran sains demi masa depan kita." Makalah disajikan dalam *Seminar Nasional Pendidikan sains di Prodi Pendidikan Sains PPs UNESA*, tanggal 16 Januari 2010.
[16] Peraturan Pemerintah nomor 17 2010 tentang Pengelolaan dan Penyelenggaraan Pendidikan
[17] Weinert, F. E., and Kluwe, R. H. 2000. *Metacognition, motivation, and understanding*. The Psychology of education and Instruction. Lawrence Erlbaum Associates, New Jersey. London: Publishers Hillsdale.
[18] Soekamto, Hadi. 2002. *Prosedur Pengembangan Perangkat Pembelajaran*. Universitas Negeri

Malang. Malang.

[19] Azizah, U., and Nasrudin, H. 2014. "Pemberdayaan Kecakapan Berpikir Siswa SMA Bertaraf Internasional Melalui Pengembangan Perangkat Pembelajaran Materi Redox Reaction Berorientasi Group Investigation Cooperative." *Jurnal Pendidikan dan Pembelajaran,* **20**(2), 141-151.

[20] Thomas, G.P. 2003. "Conceptualisation, development, and validation of an instrument for investigating the metacognitive orientation of science classroom learning environments: The metacognitive orientation learning environment scale – science (moles-s)." *Learning Environments Research,* **6** (2), 231-252.

[21] Fraenkel, Jack R., and Wallen, Norman E. 2003. *How to design and evaluate research in education*. Fifth Edition. Boston: Mc Graw Hill.

[22] Azizah, U. and Nasrudin, H. 2016. Pemberdayaan Keterampilan Berpikir Mahasiswa Melalui Pengembangan Perangkat Perkuliahan Kimia Dasar Berbasis Metakognitif. *Prosiding Seminar Nasional Kimia dan Pembelajarannya.* ISBN: 978-602-0951-12-6. 17 September 2016.

[23] Hake, R., 2002. Relationship of individual student normalized learning gains in mechanics with gender, high school physics, and pretest scores on mathematics and spatial visualization. Retrieved from: http://www.physics.indiana.edu/.

[24] Azevedo, R., and Cromley. 2004. "Does training on self-regulated learning facilitate students' learning with hypermedia?" *Journal of Educational Psychology,* **96**(3), 523-535.

[25] Ormand, Carol. 2008. *Teaching metacognition*. Retrieved from: http://serc.carleton.edu/.