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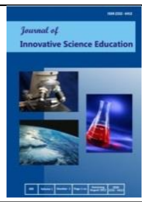

The Implementation Analysis of Metacognition Knowledge Post Problem Based-Blended Learning (PBBL) in The Hydrolysis-Buffer Material

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Abstract

Metacognition knowledge is needed in the problem-solving process. This knowledge has not been much taught and practiced to students. The research intends to provide information about (1) the profile of students' metacognition knowledge, (2) relationships, and (3) the contribution of metacognition knowledge to cognitive learning outcomes. The research subjects were 143 students of class XI SMAN 10 Semarang with research design of mixed method-sequential explanatory. Written test as a source of quantitative data and the Metacognitive Activities Inventory (MAI-1) questionnaire as a source of qualitative data. The metacognition knowledge of students is on the criteria of "ok". The relationship with cognitive learning outcomes obtained from the product moment correlation test results, r = 0.983 and the correlation coefficient significance test, Fh = 4041,84. The conclusion, there is a relationship between metacognition knowledge on cognitive learning outcomes. Contributions to cognitive learning outcomes are very high, amounting to 96.63%. PBBL is effective in empowering and training metacognition knowledge in the learning process in the classroom.

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INTRODUCTION

The shift in the level of philosophy, direction and purpose of education due to the development of 21st century science and the era of the industrial revolution 4.0 sparked a new paradigm in the educational process in Indonesia. The paradigm emphasizes the learning activities of students in the learning process, including the activity of finding out from various sources, formulating problems, analytical thinking, and collaborating with other students in the problem-solving process.

Metacognition influences and relevance (Sandi-Urena *et al.*, 2011) and plays an important role (Bahri & Corebima, 2017) in the problem-solving process. Metacognition helps students explore knowledge, plan solutions, monitor thinking processes, evaluate the processes and results of solving these problems (Murni *et al.*, 2011; Lalang & Ibnu, 2017). Metacognition is a way of thinking of one's own thoughts (Sandi-Urena *et al.*, 2012), abilities possessed by individuals related to the thought process (Haryani *et al.*, 2010), awareness in regulating ways of thinking (Anggo, 2011), and skills think explicitly about ideas or conceptions that are believed (Rompayom *et al.*, 2010).

Metacognition consists of two main subcomponents, namely: (1) knowledge of cognition (metacognition knowledge) and (2) regulation of cognition (metacognition skillfullness) (Corebima, 2009; Syafa'ah *et al.*, 2015). The division is as shown in Figure 1.

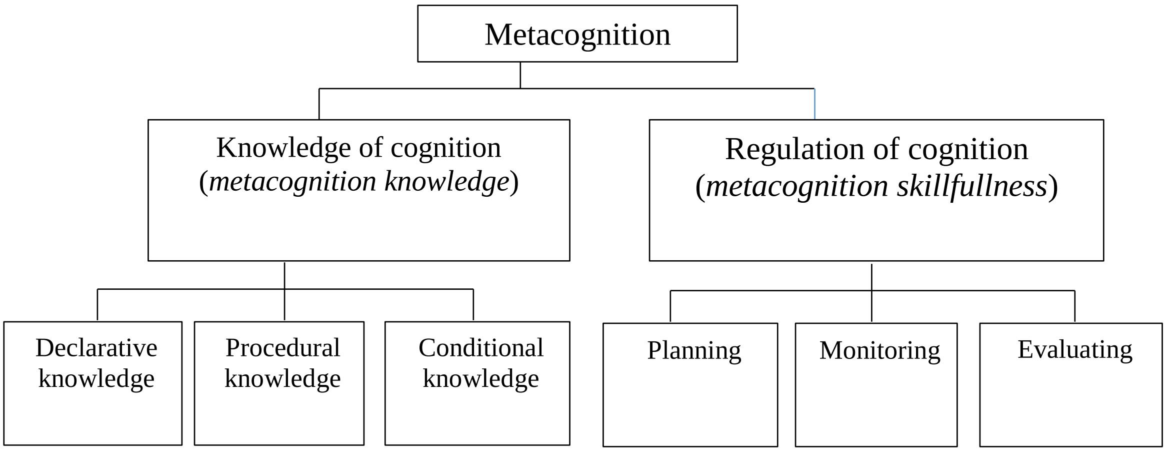

Figure. 1 Components in Metacognition (Jordan, 2011).

Research related to metacognition skills are mostly done (Cooper & Sandi-Urena, 2009; Warouw, 2010; Rae Jordan, 2011; Sandi-Urena *et al.*, 2011, 2012), but not so with knowledge of metacognition (Özsoy & Ataman, 2009; Rompayom et al., 2010).

Metacognition as a dimension of knowledge on the competency standards of high school /MA /SMALB/Package C secondary level graduates (Permendikbud number 20, 2016), has not been much trained in classroom learning (Suratno, 2010; Haryani *et al.*, 2014). Research by Warouw (2010) and Syarifah *et al.* (2016), gave the same conclusion with observations made by researchers of chemistry teaching staff in the MGMP Chemistry environment in Semarang City. Observation results showed 54.17% of the teaching staff understood and knew about metacognition knowledge, but 58.33% of the educators had not yet developed, trained and conducted an analysis of metacognition knowledge of their students.

Knowledge of cognition or metacognition knowledge is one's ability in the process of thinking explicitly about the concept of knowledge that provides an overview of individual consciousness at three different levels of knowledge (Schraw & Dennison, 1994; Cooper & Urena, 2009; Rompayom *et al.*, 2010; Jordan, 2011). Such knowledge involves the process of cognition, including knowing about things (declarative), knowing how to do something (procedural), and knowing why and when doing something (conditional) (Sandi-Urena *et al.*, 2012).

Metacognition knowledge can be developed in the learning process in the classroom

(Ekoningtyas, 2013) with a constructivist learning framework (Ozsoy & Ataman, 2009). Problem based learning (PBL) can be utilized to develop and activate metacognition knowledge by providing a favorable environment (Danial, 2010; Haryani *et al.*, 2014; Setiawan & Susilo, 2015; Kahar *et al.*, 2018). Facilities in PBL develop students' abilities in the process of thinking and constructing knowledge that is open ended, contextual and ill structured (Nuswowati *et al.*, 2017; Haryani & Wardani, 2018).

The combination of PBL with blended learning gives students space to express ideas, encourage creative and descriptive solutions to the identification of problems and help students in mastering the content of the material being studied (Veale *et al.*, 2018). Blended learning involves IT tools that combine e-learning, online mixed learning with face-to-face learning in the classroom (Afdhila *et al.*, 2018; Bain, Rodriguez *et al.*, 2018). Blended learning helps students understand concepts by utilizing technology as an assistive method, and interactive visualization media (Jihad *et al.*, 2018). Utilization of IT in the current learning process makes it possible to become a solution in overcoming learners' learning difficulties (Poedjiastoeti & Liliasari, 2010; Haryani *et al.*, 2013), and is a tool to visualize abstract chemical concepts (Rengga & Wijayati, 2011).

Hydrolysis-buffer, is one of the materials that according to the teacher and prospective chemistry teacher as material that is considered difficult by students and also difficult in teaching it in class (Haryani *et al.*, 2014). These difficulties are related to: (1) understanding of the concept; (2) mastery of the material; (3) media and facilities; (4) material and source of material; and (5) other reasons, namely ambiguous in concept.

Student difficulties related to concepts in hydrolysis-buffer material require a process of thinking cognition. The process requires ideas and ideas related to identifying and solving problems. Metacognition knowledge is needed in the process, so it needs to be trained and taught to students.

The above description provides a basis for researchers to carry out research related to the analysis of metacognition knowledge and student learning outcomes in the cognitive aspects of post problem based-blended learning (PBBL) on hydrolysis-buffer material implementation. This study aims to: (1) identify the profile of metacognition knowledge possessed by students, (2) describe the relationship of metacognition knowledge with cognitive learning outcomes, and (3) measure the magnitude of the value of the contribution made by metacognition knowledge to cognitive learning outcomes.

METHODS

The study was conducted using a mixed-method sequential explanatory design, which was designed by the method of data collection in two phases. The first phase is quantitative data collection, and the second phase is qualitative data collection (Creswell, 2016). The research took place at SMAN 10 Semarang in the even semester of the 2018/2019 academic year in March-May 2019. Subjects in the study were 143 students of class XI in the MIPA and IPS specialization program divided into 4 classes, namely class XI.MIPA-1, XI.MIPA-2, XI.IPS-1 and XI.IPS-4. The independent variable in this study is the applied learning model that is problem based-blended learning (PBBL) on hydrolysis-buffer material, and the dependent variable is metacognition knowledge and students' cognitive learning outcomes.

Quantitative data were obtained from written test results, with 10 essay questions. The level of questions consists of questions C2 (level of understanding ability) and questions C5 (level of evaluation ability). The question items in the questions are arranged by integrating indicators of competency achievement in the hydrolysis-buffer material with indicators in metacognition knowledge. Students' answers are then analyzed and scaled.

Qualitative data collection using the Metacognitive Activities Inventory (MAI-1) questionnaire, modified from Schraw & Dennison (1994), Cooper *et al.* (2008) and Jordan (2011) in the form of questionnaire responses totaling 16 statement items, in the form of a checklist with answers: 1 = very incorrect (STB), 2 = incorrect (TB), 3 = quite correct (CB), 4 = true (B), and 5 = very true (SB).

Scores obtained from test instruments and questionnaires were subsequently converted on a scale of 0-100 to determine the profile of metacognition knowledge based on Table 1.

Table 1. Metacognition Knowledge Profile Criteria

Value Scale	Criteria
0 – 16	*Not Yet*
17 - 33	*At risk*
34 - 50	*Can not really*
51 - 67	*Developing*
68 - 84	*OK*
85 – 100	*Super*

(Green in Suratno, 2010; Sholihah *et al*., 2016)

Correlation test was conducted to determine the relationship between metacognition knowledge and cognitive learning outcomes of students calculated by the equation:

$$r_{yx1} = \frac{\sum yx1}{\sqrt{(\sum y^2)(\sum x1^2)}}$$

(Sugiyono, 2011)

information:

ryx1 : product moment correlation between x1 and y

x1 : knowledge of metacognition written test results

y : cognitive learning outcomes of student

Correlation test continued with the correlation coefficient significance test using the equation:

$$F_h = \frac{R^2/k}{(1-R^2)/(n-k-1)}$$

(Sugiyono, 2011)

information:

R : product moment correlation coefficient

K : number of independent variables

n : number of research subjects

The amount of the contribution of metacognition knowledge to students' cognitive learning outcomes is expressed as a coefficient of determination, calculated by the formula:

$KD = (r)^2 \times 100\%$

(Sugiyono, 2011)

information:

KD : coefficient of determination

r : correlation coefficient ryx1

RESULTS AND DISCUSSION

Metacognition knowledge is defined as the ability of a person to think explicitly about the conception of knowledge and describe individual consciousness at three different levels of knowledge, with categories and definitions as detailed in Table 2.

Table 2. Categories and Definitions of Metacognition Knowledge.

Category	Definition
Declarative knowledge	The knowledge held by students about the information or resources needed to solve problems such as knowledge about: goals, demands on what knowledge resources are needed, and the nature of the task involved.
Procedural knowledge	Learners' knowledge or beliefs about themselves about the way, steps or procedures in solving problems. Learners' self-perceptions about their abilities about how to do things.
Conditional knowledge	Learners' knowledge about when and why to use strategies or steps for problem solving. Knowledge of situations in which students can use special skills such as techniques, and methods.

(Schraw & Dennison, 1994; Rompayom *et al*., 2010)

The metacognition knowledge profile of students based on written test results and the Metacognitive Activities Inventory (MAI-1) questionnaire are presented in Figures 2 and 3.

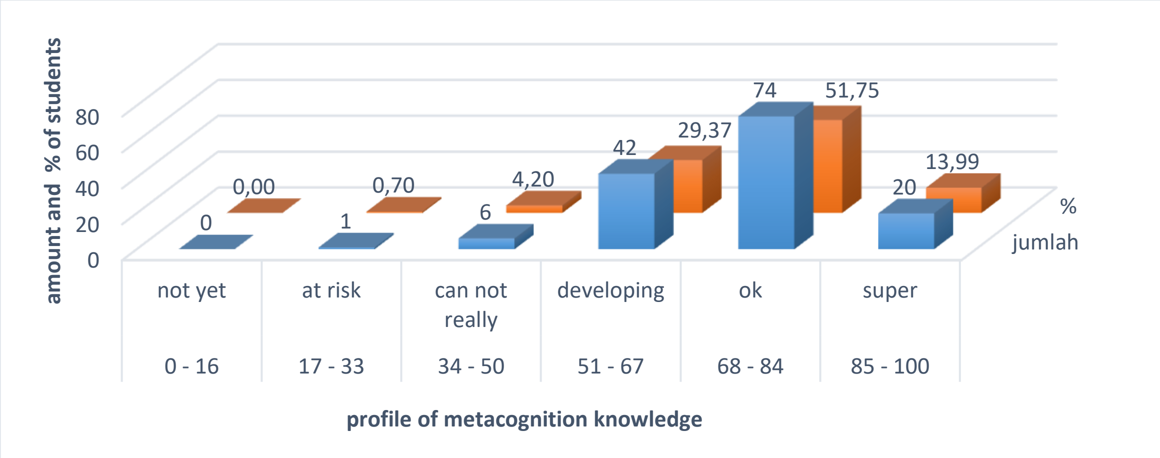

Figure 2. Metacognition Knowledge Profile Written Test Results

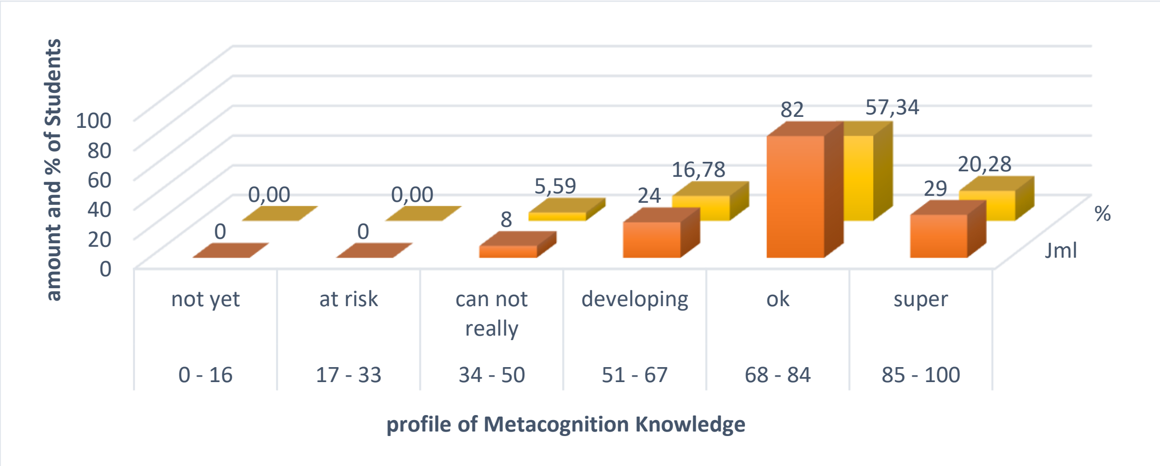

Figure 3. Metacognition Knowledge Profile Results of MAI-1 Questionnaire

Figures 2 and 3 give results that are not much different from the profile of students' metacognition knowledge. Both pictures show the highest number and percentage are in the criteria of "ok", which is equal to 51.75% and 57.34%. Achievement of these criteria shows that students have realized their abilities and knowledge of the thought process. Students can distinguish the stages in the information processing process which includes input-elaboration-output activities in their own way of thinking. Students have used examples and models, and regularly use that awareness to regulate their thinking patterns and learning processes.

Figures 2 and 3 also show that the instruments used in the form of written test instruments as a source of quantitative data and the Metacognitive Activities Inventory (MAI-1) questionnaire give the same results, are consistent and can be used together to measure participants' metacognition knowledge students.

Hypothesis testing of the relationship between metacognition knowledge and cognitive learning outcomes is carried out in two stages. The first step is calculating the value of product moment correlation (r_{x1y}) between metacognitive knowledge (x1) and cognitive learning outcomes (y). The test continued with the correlation coefficient significance test, Fh (k, n-k-1), carried out to determine the correlation significance between variables. The hypothesis given in this test is:

H0 : $\rho = 0$ (there is no relationship between metacognition knowledge with cognitive learning outcomes of students).

Ha : $\rho \neq 0$ (there is a relationship between metacognition knowledge with cognitive learning outcomes of students).

The results of the product moment correlation test and the correlation coefficient significance test with $\alpha = 0.05$ are presented in Table 3.

Table 3. Product Moment Correlation Test Results and Test Correlation Coefficient Test

Test	Result
Product moment correlation test	r_{x1y} = 0,983
Test the significance of the correlation coefficient	F arithmetic obtained value = 4041,84 F table (1.141) for α = 0.05 is 3.91 Because F arithmetic> F table, then Ha is accepted
Conclusions	there is a relationship between metacognition knowledge and cognitive learning outcomes

The contribution of metacognitive knowledge to cognitive learning outcomes is determined as a determinant coefficient test (KD), with hypotheses:

Ho : $\rho<50\%$ (there is no positive contribution between metacognition knowledge on cognitive learning outcomes of students).

Ha : $\rho \geq 50\%$ (there is a positive contribution between metacognition knowledge on cognitive learning outcomes of students).

The calculation results obtained KD value of 96.63%, which means the null hypothesis is rejected, and the alternative hypothesis is accepted. The conclusion that can be drawn from these calculations is that there is a relationship between metacognition knowledge and learning outcomes of students in cognitive aspects.

The development of the digitalization era and the industrial revolution 4.0 had a big influence on the development of education in Indonesia. Students are not only required to succeed and achieve mastery of learning outcomes in cognitive, psychomotor, and affective aspects, but also demand mastery of IT and other high-level abilities, one of which is ability to solve problems.

Students' mastery of IT and problem-solving skills can be facilitated by implementing a right learning process in the classroom. Problem based-blended learning (PBBL) can be used to achieve these goals. PBBL involves components in a blended learning approach, namely: online, offline, e-mobile, and face to face (Husamah, 2014; Dwiyogo, 2018) with the learning phases in PBL (Munir, 2017).

PBBL facilitates active students in their own learning that involves cognition, and their own thought processes. The process makes students able to choose which information will be studied, compile meaning and directly apply the information that has been selected (Suwarto, 2010; Setiyono, 2011). The activity involves metacognition knowledge possessed by students.

Hydrolysis-buffer material requires metacognition knowledge in identifying problems. Solving problems related to hydrolysis-buffer concepts requires a strong cognitive thinking process and requires ideas and ideas in the effort to solve the problem.

The results showed that the amount and percentage of post-PBBL metacognition knowledge profile on the hydrolysis-buffer material were in the "ok" criteria, namely 51.75% of the written test results and 57.34% of the results of the MAI-1 questionnaire. These results illustrate that students consciously use their own way of thinking and learning processes on knowledge related to all information and learning resources needed to understand and solve problems related to hydrolysis-buffer material.

As a dimension of knowledge on the competency standards of high school / MA/SMALB/Package C secondary level graduates (Permendikbud number 20, 2016), the results of the study indicate that there is a positive relationship between metacognition knowledge and cognitive learning outcomes of student. The contribution given by metacognition knowledge to cognitive learning outcomes is very high, which is 96.63%, according to the results of research conducted by Bahri & Corebima (2017).

Metacognition knowledge provides students with understanding to take steps in the problem-solving process, involving knowledge that is factual, conceptual, procedural, and conditional (Scherer & Tiemann, 2012). Good metacognition knowledge will direct students' thinking processes to higher order thinking skills (Kritis et al., 2015; Bahri & Corebima, 2017) which ultimately helps students in achieving cognitive learning outcomes.

This research provides information that PBBL is effective in learning and practicing metacognition knowledge to students. The results of this study are in line with the results of research by Rompayom et al. (2010), Haryani et al. (2014.), and Kritis et al. (2015), that computer-aided problem-based learning (IT) can be used to develop metacognition knowledge. PBBL allows students to ask themselves questions about what they are doing and utilize online media to find sources of knowledge needed. Building an appropriate discussion environment and asking effective questions to students can be done to empower metacognition knowledge in the learning process in the classroom (Ozsoy & Ataman, 2009).

CONCLUSION

After learning PBBL hydrolysis-buffer material, the metacognition knowledge profile possessed by students of class XI in the MIPA and IPS specialization program are in the "ok" criteria based on the acquisition of quantitative data analysis (51.75%) and qualitative (57.34%). Metacognition knowledge has a positive relationship and gives a very high contribution to the cognitive learning outcomes of students. PBBL is identified to be effective and can be used in learning and training students' metacognitive knowledge.

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