ISSN No:-2456-2165

Development of Physics Metacognition Learning Models; an Inovative Learning in Indonesia

Muhammad Nasir
Senior High School 8
Samarinda, Road Untung
Suropati of Kunjang River,
East Kalimantan, Indonesia

Madlazim,
Department of Education MIPA,
Universitas Negeri Surabaya,
Ketintang St., Surabaya 60231,
Indonesia

I Gusti Made Sanjaya,
Department of Education MIPA,
Universitas Negeri Surabaya,
Ketintang St., Surabaya 60231,
Indonesia

Wahyudi
Senior High School 8
Samarinda, Road Untung
Suropati of Kunjang River,
East Kalimantan, Indonesia

Abstract:- Preliminary study results showed that in general, problem-solving capabilities and the state SCHOOL of Samarinda Metakognisi still low. Therefore, researchers developed a learning model capable of improving problem-solving skills and metacognition. The purpose of this research is to obtain the feasibility of components and measuring instruments reliability. Data validation results are obtained through Focus Group Discussion by three experts in the field of physics and education. Metacognition Physics Learning model developed needs to be validated by experts through Focus Group discussions. The expert validation results of the MI-PML model book components are valid and the instruments used are reliable. MI-PML can be implemented in learning to improve problem-solving skills and Metakognisi.

Keywords:- *Content Validity; Construct Validity; and PML Model.*

I. INTRODUCTION

Related to the enforcement of 2013 Curriculum that obligates the education to keep improving its curriculum in order to make it not being outdated. This "not being outdated" context refers to the necessity of education for a curriculum that is able to adapt tp 21st century development, especially problem solving and metacognition. Metacognition is important dimension from Bloom Taxonomy Revised. The research result (Prahani, Nur, & Yuanita, 2016), (Griffin & Care, 2015), and (Rosen, 2014) showed that the collaborative problem solving skill is very needed by the students in school level and in the real social situation. According to the preliminary study result (Nasir, Madlazim, & Sanjaya, 2016) showed that problem solving and metacognition skills of Senior High School (SMA) students in Samarinda are still low.

It is allegedly due to still there is no any physics teaching materials that are equipped with material delivery model completely (Nasir, Madlazim, & Sanjaya, 2016). Learning activity is only directed to the ability of students for memorizing *(mnemonic)* information. As the result, they have no idea about what *(knowledge)* they have learned, why *(attitude),* and how *(skills)* is the meaning of the theory they have memorized before (Darling-Hammond, Austin, Cheung, & Martin, 2003). According to Holt (2012) proposed that the teachers nowadays are lack of idea about what they teach, how they teach, and test it (Holt, 2012). Metacognitive knowledge is often ignored whereas it is very necessary on achieving the education objectives. Metacognitive knowledge is not easy to get but it needs full understanding about what metacognitive is and how metacognitive knowledge can be possessed by every students (Indrarini, Sadono, & Onate, 2013).

This makes the understanding of physics concept is being low that is allegedly can cause the problem solving and metacognition skills of the students are being low as well. This problem needs solution, and one of the alternative solutions is by developing the model of physics metacognition learning (PML) on physics learning because theoretically or the result of the research model is potentially improve problem solving skill, and improve metacognition ability of the students. According to that potency, then the PML model is developed on this research. PBL integration and Metacognitive Strategy have not been developed before to improve problem solving skill, and metacognition ability of the students. That shows the importance and high expectation on learning to improve problem solving skill and metacognition of Senior High School (SMA) students in Indonesia.

The problem about the problem solving and metacognition skills that are still low can be handled with Problem Based Learning (PBL) model. Problem Based Learning model still has some weaknesses (Skinner, Braunack-Mayer, & Winning, 2015); (Ageorgers, Bacila, Poutot, & Blandin, 2014); (Temel, 2014); (Batdi, 2014); (Klegaris, Bahniwal, & Hurren, 2013); (Ibrahim, 2012); (Imafuku, Kataoka, Mayahara, Suzuki, & Saiki, 2014); (Arends, 2012); (Celik, Onder, & Silay, 2011); (Nur M., 2011); (Sockalingan & Schmidt, 2011). The detentions of PBL model are it is not suitable for the big information scope or basic knowledge and some teachers do not

encourage its functions (Arends, 2012). When the students have not had and understood the basic concept, then they will find a difficulty in problem solving. The research result from the samples of 24 university students as the prospective teachers showed that the use of PBL can improve their learning outcome of physics subject, yet their investigation and collaborative ability in problem solving are still low (Celik, Onder, & Silay, 2011).

The main points of the literature review above strengthen that PBL model still has some weaknesses, as the result, the researcher innovated to develop physics metacognition learning model which is expected to improve the problem solving, and metacognition skills of the students. A good learning model must fulfill 3 terms, they are: 1) validity, 2) practicality, and 3) effectiveness (Nieveen, 1999). This research focuses on getting the content validity and construct from physics metacognition learning model to improve the problem solving and metacognition skills of the students.

II. RESEARCH

Physics metacognition learning (PML) learning model which is developed and validated by 3 experts in a discussion forum that is commonly called Focus Group Discussion (FGD). Focus Group Discussion (FGD) is a little group discussion where the participants respond a series of questions that is focused on one topic (Marrelli, 2008). FGD result becomes references to revise PML learning model. Physics metacognition learning (PML) learning model validity is assessed based on content validity and construct validity. Validity is divided into 2 parts, they are content validity and construct validity (Nieveen, 1999). Content validity is "there is a need for the intervention and its design is based on state-of-the-art (scientific) knowledge." (Nieveen, McKenny, &Akker, 2007). The assessment of content validity is reviewed from some assessment aspects below, they are: 1) the necessity of PML learning model development, 2) state of the art of knowledge, 3) the theoretical and empirical support of PML learning model, 4) the planning and implementation of PML model learning, 5) the learning environment of PML learning model, 6) the use of evaluation techniques (Arends, 2012); (Nieveen, McKenny, &Akker, 2007); (Joyce & Weil, 2003). Construct validity is "the intervention is 'logically' designed" (Nieveen, McKenny, &Akker, 2007). The assessment of concstruct validity is reviewed from some assessment aspects below, they are: 1) the necessity of PML learning model development, 2) the theoretical and empirical support of PML learning model, 3) the planning and implementation of PML model learning, 4) the learning environment of PML learning model, 6) PML learning model: a last thought (Arends, 2012). PML model validity is determined by referring to validity criteria in **Table no:1**.

Percentage Average	Criteria
21% - 36%	Invalid
37% - 52%	Less Valid
53% - 68%	Enough
69% - 84%	Valid
85% - 100%	Best Valid

Table 1:- Validity Assessment Criteria

(Nasir, Madlazim, &Sanjaya, 2016)

Learning model validation sheet is used for gaining learning model validity. Validation sheet is filled by the expert who analyzed and assessed the learning model that is developed by the researcher on Focus Group Discussion (FGD). The calculation of GSL learning model validity instrument reliability is based on interobserver agreement that is gained from the analysis of statistic percentage of agreement (R) (Borich, 1994). The developed instrument is considered reliable if its percentage is $\geq$ 75% (Borich, 1994). The calculation of PML learning model validity instrument reliability is strengthened by using Cronbach's Alpha analysis (R, Wallen, & Hyun, 2012). The reliability result of PML learning model validation is using reference (Hinton, McMurray, & Brownlow, 2014).

III. RESULT

Physics Metacognition Learning (PML) learning model that is developed for improving the problem solving and metacognition skills of Senior High School (SMA) students refers to the problem solving process plot by John Dewey. In *Democracy and Education* (1916), John Dewey described a view about education with school as a bigger mirror of citizens and the class will be a laboratory for investigation and problem solving in real life. John Dewey (1910) proposed that problem solving is an intentional process that consists of these following steps: figuring out the problem, identifying the nature of the problem, developing the hypothesis to solve the problem, verifying the different hypothesis, and choosing the most appropriate alternative between those hypotheses (Moreno, 2010).

PML learning model that will be developed is supported with learning theories, they are social-interdependence theory, constructivism socio-cognitive theories, cognitive theories of learning, behavioral theories of learning, and motivation theories of learning. Empirical result is also used to support PML model development based on Problem Based Learning model that still has some weaknesses (Skinner, Braunack-Mayer, & Winning, 2015); (Ageorgers, Bacila, Poutot, &Blandin, 2014); (Temel, 2014); (Batdi, 2014); (Klegaris, Bahniwal&Hurren, 2013); (Ibrahim, 2012); (Imafuku, Kataoka, Mayahara, Suzuki, & Saiki, 2014); (Arends, 2012); (Celik, Onder, &Silay, 2011); (Nur M., 2011); (Sockalingan& Schmidt, 2011). According to the argument of researcher that is supported by theory

review and empirical review then the syntax learning model is formed with five phases, they are 1) predict, 2) discuss, 3) observe, 4) associate, and 5) evaluate. The main purpose of this model is for improving the problem solving, and metacognition skills of the students. On this model, students are expected to be pro-active and have a high awareness in problem solving activity for improving the metacognition of the students, so that physics learning model that is developed, is called "physics metacognition learning PML)". The assessment result of the expert, and validation score data analysis of all items that is found on MP-PML validation sheet instrument and each results of content validation and construct validation are shown on **Table no:2 & Table no:3**.

No.	Descriptions of validated model activity	Maximum Score	Validator			Average	%	Explanation
			1	2	3			
1	PML Learning Model Rational (n=5)	25	18	21	18	19.00	76.00	Valid
2	The support of learning theories (n=4)	20	16	20	16	17.33	86.67	Best Valid
3	PML Learning Syntax (n=6)	30	24	25	24	24.33	81.11	Best Valid
4	Social system (n=3)	15	12	14	12	12.67	84.44	Best Valid
5	Reaction principle (n=4)	20	16	16	16	16.00	80.00	Valid
6	Supporting system (n=3)	15	14	14	14	14.00	93.33	Best Valid
7	Instructional and accompanist effect (n=4)	20	16	15	16	15.67	78.33	Best Valid
8	Learning implementation instruction (n=6)	30	20	24	19	21.00	70.00	Valid
9	Evaluation (n=6)	30	27	25	27	26.33	87.78	Best Valid
10	Model quality in general (n=2)	10	8	8	8	8.00	80.00	Best Valid
	Average		17.10	18.20	17.00	17.43	81.77	Best Valid
	Decision		Worth to Use					

Table 2:- MP-PML Content Validation Score

No.	Descriptions of validated model activity	Maximum Score	Validator			Average	%	Explanation
			1	2	3			
1	PML Learning Model Component (n=5)	25	15	20	24	19.67	78.67	Valid
2	Supporting theories (n=2)	10	8	8	10	8.67	86.67	Best Valid
3	PML Learning Syntax (n=3)	15	12	12	14	12.67	84.44	Best Valid
4	Social system (n=5)	25	20	20	24	21.33	85.33	Best Valid
5	Reaction principle (n=5)	25	20	20	24	21.33	85.33	Best Valid
6	Supporting system (n=3)	15	12	13	14	13.00	86.67	Best Valid
7	Instructional and accompanist effect (n=5)	25	20	20	24	21.33	85.33	Best Valid
	Average		15.29	16.14	19.14	16.86	84.63	Best Valid
	Decision		Worth to Use					

Table 3:- MP-PML Construct Validation Score

IV. DISCUSSION

According to the assessment from expert shows that developed MP-PML has valid content validity, it is 81.77%. MP-PML components have a very high robustness of theoretical foundation and learning model components (syntax, reaction principle, social system, supporting system, and instructional and accompanist effect) internally have best valid consistency, it is 84,63%. The achievement of construct validation percentage result in a best valid range, so that it is worth to use in physics learning di Senior High School (SMA). The opinion of those three expert validators, propose that MP-PML is worth to use with improvement. The validation result shows that MP-PML learning syntax is approved to be applied in physics learning in Senior High School (SMA).

The expert assessment result shows that MP-PML is included in valid category, both in content validity and construct validity. Valid MP-PML has a meaning that the model has had the state of the art knowledge, had a strong theoretical and empirical foundation, and there is the consistency between model components, this is appropriate with the good model characteristics (Nieveen, Mc Kenny, & Akker, 2007); (Arends, 2012).

Comments and suggestions of three expert validators are:

- Validator 1 : the learning model has been suitable with the learning model principle, yet it needs to be noticed when model implementation towards time necessity. This model is worth to use with improvement.
- Validator 2 : seeing that model syntax has been suitable with 2013 Curriculum. This model is worth to use with improvement.
- Validator 3 : this model has been worth to use in physics learning in Senior High School (SMA). This model is worth to use with improvement.

V. CONCLUSION

Developed MP-PML content validity assessment has best valid category, percentage of agreement from PML model construct validity assessment is 81.77% classified reliable, whereas Cronbach's Alpha shows 0.978 on excellent reliability criteria. Developed MP-PML construct validity assessment has best valid category, percentage of agreement from PML model content validity assessment is 84.63% classified reliable, whereas Cronbach's Alpha shows 0.986 in excellent reliability criteria. MP-PML can be implemented in physics learning in Senior High School (SMA) to improve problem solving and metacognition skills of SMA students.

VI. SUGGESTION

This research result needs advanced research, especially the implementation in learning process at the class. The practicality and the effectiveness of the developed model can be seen in learning process with PML model implementation. A relevant advanced research is for seeing and reviewing the practicality and the effectiveness of PML model.

THANKING

The writer says thanks to Prof. Dr. H. Muslim Ibrahim, M.Pd. (A professor and Education Expert, Universitas Negeri Surabaya); Prof. Dr. H.Sutarto, M.Pd, (a professor and Education Expert, Universitas Negeri Jember); Zainul Arifin Imam Supardi, Ph.D (Physics Expert and Education Expert, UniversitasNegeri Surabaya) who have disposed to validate PML model and give moral support for this research.

REFERENCES

[1]. Prahani, B. K., Nur, M., & Yuanita, L. (2016). *Model Group Science Learning untuk Meningkatkan Keteramplan Pemecahan Masalah Kolaboratif, Keterampilan Proses Sains, dan Kepercayaan Diri Siswa SMA* . Surabaya: Unesa.

[2]. Griffin, P., & Care, E. (2015). *Assessment and Teaching of 21st Century Skills.Methods and Approach*. Dordrecht: Springer.

[3]. Rosen, Y. (2014). Comparability of Conflict Opportunities in Human-to-Human and Human-to-Agent Online Collaborative Problem Solving. *Technology, Knowledge and Learning* , 147–164.

[4]. Nasir, M., Madlazim, & Sanjaya, I. G. (2016). Studi Pendahuluan Keterampilan Pemecahan Masalah Dan Metakognisi Siswa SMA Berbasis UAPAC + SE. (Madlazim, & I. G. Sanjaya, Eds.) *Prisma Sains, Vol 4. No.01* , 42-52.

[5]. Darling-Hammond, L., Austin, K., Cheung, M., & Martin, D. (2003). *Thinking About Thinking.* Stanford: University School of Education.

[6]. Holt, J. (2012). *Bagaimana Siswa Belajar.* Jakarta: Erlangga.

[7]. Indrarini, E., Sadono, T., & Onate, M. E. (2013). Pengetahuan Metakognitif untuk Pendidik dan Peserta Didik. *Satya Widya, Vol. 29, No.1* , 40-46.

[8]. Skinner, V. J., Braunack-Mayer, A., & Winning, T. A. (2015). The Purpose and Value for Students of PBL Groups for Learning. *Interdisciplinary Journal of Problem-based Learning, 9 (1)* .

[9]. Ageorgers, P., Bacila, A., Poutot, G., & Blandin, B. (2014). Some Lessons from A 3-Year Experiment of Problem Based Learning in Physics in A French School of Engineering. *American Journal of Educational Research, 2 (8)* , 564-567.

[10]. Temel, S. (2014). The Effects of Problems Based Learning on Pre Service Teacher's Critical Thinking Dispotitions and Perceptions of Problems Solving Ability. *South African Journal of Education, 34 (1)* , 1-20.

[11]. Batdi, V. (2014). The Effects of Problem Based Learning Approach on Students Attitude Levels : A meta-analysis. *Educational Research and Reviews, 9 (9)* , 272-276.

[12]. Klegaris, A., Bahniwal, M., & Hurren, H. (2013). Improvement in Generic Problem Solving Abilities of Students by Use of Tutor-Less Problem-Based Learning in a Large Classroom Setting. *Life Sciences Education, 12* , 73-79.

[13]. Ibrahim, M. (2012). Pembelajaran Berdasarkan Masalah (PBM).

[14]. Imafuku, R., Kataoka, R., Mayahara, M., Suzuki, H., & Saiki, T. (2014). Students Experiences in Group Interaction. *Interdisciplinaru Journal of Problem-Based Learning, 8 (2)* , 1-19.

[15]. Arends, R. (2012). *Learning to Teach: Fifth Edition.* New York: McGraw-Hill.

[16]. Celik, P., Onder, F., & Silay, I. (2011). The Effects of Problem-Based Learning on Students Succes in Physics Course. *Procedia-Social and Behavioral Sciences, 28* , 656-600.

[17]. Nur, M. (2011). *Model Pembelajaran Bedasarkan Masalah.* Surabaya: Pusat Sains dan Matematika Sekolah Unesa.

[18]. Sockalingan, N., & Schmidt, H. G. (2011). Characteristics of Problem for Problem-Based Learning: The Students Perspective. *Interdisciplinary Journal of Problem-Based Learning, 5 (1)* , 6-33.

[19]. Nieveen, N. (1999). *Prototyping to Reach Product Quality.* Netherlands: Spinger.

[20]. Marrelli, A. F. (2008). Collecting Data Through Focus Groups. *Performance Improvement, 47* .

[21]. Nieveen, N., McKenny, S., & Akker, V. (2007). *Educational Design Research.* New York: Routledge.

[22]. Joyce, B., & Weil, M. (2003). *Models of Teaching 5th Edition.* Pearson Education Inc.

[23]. Borich, G. (1994). *Observation Skill for Effective Teaching.* New York: Mac Millan Publishing Company.

[24]. R, F. J., Wallen, N. E., & Hyun, H. H. (2012). *How to Desig and Evaluate Research in Education (8th edition).* New York: McGraw-Hill.

[25]. Moreno, R. (2010). *Educational Psychology.* John Wiley and Sons.