p-ISSN 1693-1246
e-ISSN 2355-3812
January 2017

Jurnal Pendidikan Fisika Indonesia 13 (1) (2017) 25-32
DOI: 10.15294/jpfi.v13i1.10154

http://journal.unnes.ac.id/nju/index.php/jpfi

THE PROBLEM SOLVING LEARNING MODEL BY USING VIDEO RECORDING ON EXPERIMENTS OF KINEMATICS AND DYNAMICS TO IMPROVE THE STUDENTS COGNITION AND METACOGNITION

P. S. Mariati*, M. T. Betty, S. Sehat

Jurusan Fisika, Fakultas Matematika dan Ilmu Pengetahuan Alam, Universitas Negeri Medan, Indonesia

Received: 20 August 2016. Accepted: 25 September 2016. Published: January 2017

ABSTRACT

This research aimed to improve students's cognition and metacognition through kinematics and dynamics of particle experiment assissted by video recording and tracker software analysis. The research used problem solving learning model which developed using R & D method with 4-D steps, they are define, design, develop, and disseminate. The research involved 86 physics education students academic year 2013/2014 at one of the universities in Medan. The research method is quasi-experimental using randomized control group pretest-posttest design. The experimental class used problem solving learning model assisted by video recording and the control class used direct learning model. The cognition data were collected using multiple-choice test and meta-cognition data were collected using essay test. The students's cognition and metacognition improvement characterized by the normalized gain score. The research result show that the use of video recording and tracker software analysis was improve the students' cognition and metacognition in Kinematics and Dynamics topic in moderate category.

ABSTRAK

Penelitian ini bertujuan untuk meningkatkan kognisi dan metakognisi siswa melalui eksperimen kinematika dan dinamika berbantuan rekaman video dan analisis perangkat lunak pelacak lintasan. Penelitian ini menggunakan pemecahan masalah model pembelajaran yang dikembangkan dengan menggunakan metode R & D dengan langkah-langkah 4-D, yaitu mendefinisikan, mendesain, mengembangkan, dan menyebarluaskan. Penelitian ini melibatkan 86 mahasiswa pendidikan fisika tahun akademik 2013/2014 di salah satu perguruan tinggi di Medan. Metode penelitian ini adalah kuasi-eksperimental menggunakan kelompok kontrol acak desain *pretest-posttest*. Kelas eksperimen digunakan model pembelajaran pemecahan masalah dibantu oleh rekaman video dan kelas kontrol dengan model pembelajaran langsung. Data kognisi dikumpulkan menggunakan test pilihan ganda dan data meta-kognisi dikumpulkan dengan menggunakan tes esai. Peningkatan kognisi dan metakognisi mahasiswa ditandai dengan skor gain yang dinormalisasi. Hasil penelitian menunjukkan bahwa penggunaan rekaman video dan analisis perangkat lunak pelacak lintasan mampu meningkatkan kognisi dan metakognisi mahasiswa pada topik Kinematika dan Dinamika dalam kategori sedang.

Keywords: problem solving learning model; cognition; metacognition

INTRODUCTION

Generally, physics learning at classroom, whether for based level to higher level education faced some problems. Learning activity still used traditional method, that is direct learning model (Selcuk, Caliskan, & Sahin, 2013; Gok & Silay, 2008) and non-contextual (Mariati, 2012). Questions given to students has always struggled with mathematics equations and very rarely associated with contextual issues. This phenomenon led to the development of students's cognition and metacognition about physics problems of less highly trained optimally.

***Correspondence Address:**
Jl. Willem Iskandar Pasar V Medan Estate, Medan, 20221
E-mail: mariati_ps@yahoo.co.id

Physics in higher education should be taught by presenting daily life problems to practice their higher order thinking skills, such as cognition and metacognition. Therefore, managing the learning activity to fulfill the principles of better teaching and learning in higher education such as students centered learning, learning by doing, autonomous learning, as well as cooperative learning. In accordance to the principles, the learning activity is expected not only focused on lecturer activities but moreover the students activities in their learning process, especially in General Physics subject.

General Physics is one of compulsory subject for physics teacher candidate in higher education. The subject is given at the first semester since the subject is a pre requirement to the next semester program. This subject is the basis of the development of the engineering, design, planning, and technology. Therefore, the subject has an important role in various parts of live and and indirectly build the pattern of human thought. Unfortunately, General Physics is one of subject that considered as a difficult subject by the students, whereas it is a basic and essential subject that should be mastered by the students. If the student does not master it well, then it is very possible for them to have difficulty attended the lectures in the next semester.

Based on observation result in one of higher education in Medan, it is found that the General Physics learning result is still low. This is because more half of student is less interest in learning Physics and they considered it as a difficult subject. Gok & Silay (2008) stated that learning result of Physics is lower than other subject because it considered as one of difficult subject by student, so the students less interest in learning Physics. It is very common that sains, especially Physics, is considered as a difficult and not so favored subject (Setiawan, 2009). Based on the results of several studies, there are several reasons why physics is not so favored, among others: it is need complicated mathematics (AAPT, 2009); to many material and need laboratory activity (Sheppard & Robin, 2009; K. Heller, 1999); and often take misconception (Anderson & Nashon, 2006). The reasons also occurred in this research subject. The students do not seem enthusiastic when already up on materials related to a sufficiently complex mathematical formula; the material is quite dense and they could not connect them with other physics concepts; and considers laboratory experiments do not support the concept mastery

The prelemenary study show that General Physics learning results were not accordance with the standard yet. The learning process was not fully support the development of the students's cognitive such as skills to memorize, to comprehend, to apply, to analyse, to evaluate, as well as to creat, and their metacognition. Importances of cognition and metacognition development in learning activity have been reported by previous researcher (Kipnis & Hofstein, 2007; Weinert & Kluwe, 1987). According to Kipnis & Hofstein (2007), metacognition is an important component in science since metacognition processes gives meaningful learning, provides the student to learn the benefit of science in a future, and supports the students to learn autonomous. The idea also supported by Weinert & Kluwe (1987) who suggested that Higher Education should become ideal place for meta-cognition development. It is because there is so many learning of self-awareness in continuing the learning process. In Higher Education, student has repeatedly changes to monitor and to manage their cognition, has more meta-cognition knowledge, as well as has more opportunity to achieve meta-cognition skill.

Cognition considers as what is known and taught by someone or it does include skill that related to thinking process (Matlin, 2009; Anderson & Krathwohl, 2001; Costa, 1985). Components in cognition field consist of memory, comprehension, application, analysis, evaluation, and creation (Anderson & Kratwohl, 2001). Meta-cognition is a knowledge, awareness, and control of cognition process (Matlin, 2009; Anderson & Kartwohl, 2001; Schraw & Moshman, 1995). Schraw & Moshman (1995) divided meta-cognition into two components, knowledge and skill of meta-cognition. Meta-cognition knowledge defined as knowledge and comprehension in thinking process. Meta-cognition skill defined as control in thinking process. Three components of meta-cognition knowledge are declaration, procedural, and conditional. Four components of meta-cognition skill are prediction, design, monitor and evaluation.

Students cognition and meta-cognition can be developed through problem solving learning. Tan (2004) and Foshay & Kirkley (2003) said that problem solving model can influence student's cognition. More over Foshay & Kirkley (2003) said that with learning model of problem solving, cognition can be developed by using presented the problem, find solution,

and evaluation. Hollingworth & McLoughlin (2002) found that meta-cognition can be improved in a learning environment of problem solving and problem solving learning (Winert & Kluwe, 1987).

In this research Physics learning model is set based on problem solving environment in order to increase students cognition and meta-cognition. Problem solving process in this context is done by experiment and contextual problem solving. Experiment based on problem solving was set to train the students in making prediction, answering question, setting design, doing exploration, doing measurement, analyzing, and making conclusion (K. Heller &P. Heller, 1999). The problem solving steps in the experiment guide the students when they doing experiment which assisted by video using software tracker. This software functions as mathematics program of the project in video and cut up object position that move every time. The benefit of the video usage to experiment activity such as 1) to investigate the problem of real life situation, 2) can be accessed anytime, 3) present moving things in two dimension, and 4) can be varied easily so that it help the student to construct and develop comprehension concept (Teese, 2007; Zollman, 2001). Therefore, the aim of the research is to develop the Physics learning model based on problem solving to increase the student cognition and meta-cognition.

METHOD

In order to develop Physics learning model based on problem solving, method of R and D through four steps that is define, design, develop, and disseminate was used (Thiagarajan, D. Samuel, & M. Semmel, 19974). Procedure of research and development model based on problem solving in definition stage (define) is conducted through need analysis by collecting various information related to the product that will develop. Collecting various informations was conducted by prelimenary study through literature and field study. The results of literature and field study were used as a material to design a set of prelimenary product that is physics learning model and learning equipment to support the model. The products are 1) guidance of learning management; 2) syllabus and lesson plan based on problem solving; 3) student work sheet; 4) test (cognition and meta-cognition test). Product development conducted with expert validation, limited try out test, and wider scale test.

The method of limited try out test used in this research is quasi experiment with randomize control group pretest-posttest design. The samples are 86 physics teacher candidate consits of 47 students in experiment group and 39 students in control group. The cognition test is multiple choices which consist of 20 items of kinematics particle topic and 20 items of dynamic particle topic. The test includes indicators in cognition domain they are memory, comprehension, application, analysis, evaluation and creation (Anderson & Krathwohl, 2001). Test meta-cognition is essay test which consist of 8 items of kinematic particle topic and 8 item of dynamic particle topic. The indicators of meta-cognition test are prediction, plan, monitor, evaluate, declaration, procedural and conditional (Schraw & Moshman, 1995).

Limited try out conducted to see the effectiveness implementation of physics learning model based on problem solving towards cognition and meta-cognition of the students. Activeness implementation of problem solving model to increase cognition and meta-cognition was determined based on mean score of gain that normalized, N-gain. The N-gain can be classified as follows: 1) if N-gain > 70%, so N-gain is in high category; 2) if 30 % ≤ N-gain ≤ 70 %, so that N-gain is in moderate category; and 3) if N-gain < 0%, so N-gain is in low category (Hake & Richard, 2002).

Syntax of problem solving learning model was adapted from Arends (2004) with phases are 1) oriented the student to problem, 2) organized the student to learn, 3) guided group and individual investigation, 4) develop and presented investigation result, 5) strengthened and reflection syntax of conventional learning model started from introduction, main activity and closing.

Meta-cognition knowledge can develop through syntax of problem solving learning because when the problem is present, the student will be guided to realize what they already know and what they should know. Student demanded to be able to relate between one to other concept and connected those concepts with their previous knowledge. Procedural knowledge can be developed because in conducting experiment, student should know about what the procedure of problem solving. Conditional knowledge can be developed because student should know the reason why they use the problem solving strategy and know what is the right and appropriate strategy to solve the problem.

Meta-cognition skill also can be developed through problem solving, because student demanded to make prediction before conducted next investigation, student also demanded to plan their own experiment because in student work sheet there is no work procedure. In planning experiment, students prepare what will they do, choose data or information that given, and choose the right and efficient mean from available experiment equipments. By designing their own experiment, student will be challenging and motivating to collect information from various sources to solve the problem that they faced. Students will have a competent in monitoring because they demand to do correction of their investigation phases whether it accordance to the plan that they made before or not. Students will also have a competent in evaluation because they were demanded to assess whether analysis results are suitable with the theory and to assess the procedure accuracy that used and made conclusion after doing investigation.

RESULTS AND DISCUSSION

Based on the expert assessment, generally the content and construction of the test is fulfilling criteria to measure the students' cognition and meta-cognition.

Effectiveness of *problem solving* learning model in increasing student' cognition

Effectiveness test of problem solving learning model in increasing students' cognition is descibed using N-gain percentage of kinematic and dynamic particle topics. Results of normality test, homogeneity test, and mean different test of N-gain percentage of control and experiment group in kinematic and dynamic particle topic are shown in Table 1. Based on Table 1 it shows that N-gain percentage of student cognition of experiment and control group is normal distribution and homogeny variant. The N-gain percentage between two groups by using different test (t-test) shows that implementation of physics learning model based problem solving can increase significantly the student cognition in kinematic and dynamic particle topic.

Based on Table 1, the students' cognition achieved by experiment group is higher than control group. It can be concluded that implementation of learning model of problem solving assisted video in kinematic and dynamic particle topic can be more effective to increase the students' cognition compare to usage of conventional learning model.

N-gain percentage of cognition which explains each indicator between experiment and control group is shown in Figure 1. N-gain percentage of cognition is lower for experiment and control group occur in cognition domian is for creating things. It is because creating work has a high difficult level compared to other cognition aspects (memory, comprehension, application, analysis, and evaluation)

N-gain of percentage in memory and comprehension aspects of experiment group is higher than other cognition aspect. It is because in problem solving phases, when data of experiment in form of video recording were analyzed using software tracker, student can more memorize and understand. The students have opprtunity to conduct investigation through experiment autonomy. The learning model support the students to strenghthen their memory and comprehension in constructing and developing their concepts.

Effectiveness of problem solving learning model in increasing students' meta-cognition.

Result of normality test, homogeneity test and mean different test of *N-gain* percentage between experiment and control group in kinematic and dynamic particle topics is shown at Table 2. The N-gain percentage of student

Table 1. Cognition result achieved by both groups.

Topic	Experiment group				Control group				Varians % N-gain$_{Exp}$ with % N-gain$_{Cont}$	p
	Mean		N-gain (%)	Category	Mean		N-gain (%)	Category		
	Pre test	Post test			Pre test	Post test				
Kinematics	21.91	65.21	56	moderate	26.67	54.74	38	moderate	homogen	0.000 (significant)
Dynamics	23.72	70.85	62	moderate	27.31	55.38	39	moderate	homogen	0.000 (significant)

Maximum score: 100

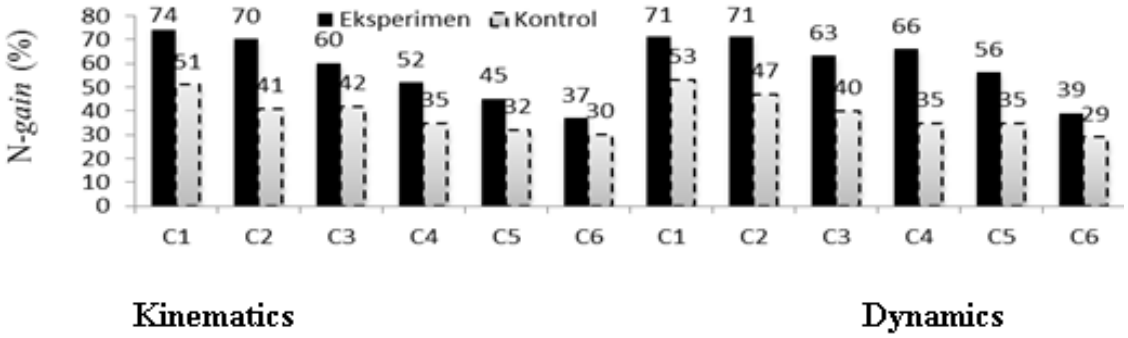

Figure 1. Comparison of cognition *N-gain* percentage on Kinematic and Dynamic particle topics based on experiment and control group indicator. The indicators: C1 = memory, C2 = comprehension, C3 = application, C4 = analysis, C5 = evaluation, C6 = creation.

Table 2. Results of meta-cognition achieved by both group

Topic	Experiment group				Control group				Varians % N-gain$_{Exp}$ with % N-gain$_{Cont}$	p
	Mean		N-gain (%)	Category	Mean		N-gain (%)	Category		
	Pre test	Post test			Pre test	Post test				
Kinematics	10.37	65.89	62	moderate	12.10	52.88	46	moderate	homogen	0.000 (significant)
Dynamics	9.38	70.94	68	moderate	10.90	61.06	56	moderate	homogen	0.000 (significant)

Maximum score: 100

meta-cognition at Kinematic and Dynamic particle topics, both groups has normal distribution and the variant is homogen. Different significant of N-gain percentage increase meta-cognition of experiment and control group used different test. Results of different test show that implementation of learning model based on problem solving more effective to increase students' meta-cognition significantly.

Based on Table 2, it is shown that meta-cognition achievement gain by experiment group is higher than control group. It can be concluded that implementation of problem solving learning model using video recording analysis at Kinematic and Dynamic topics is more effective to increase students' meta-cognition compared with usage of conventional learning model. The percentage of N-gain meta-cognition explains each of indicators between experiment and control group as shown in Table 3.

N-gain percentage of meta-cognition achieved by experiment group is higher if compared to control group. It is because in problem solving phases through experiment, student demanded to be able to predict the solution of the problem, to plan what will they do, to do investigation procedural phase, to monitor, as well as to evaluate the process. When the student prepare the plan of the experiment, they were challenged and pushed to think about every procedural phase and goal from each phases. So that, the students were trained to find out various informations and discuss them with their peer about their ideas to solve the problem. It is accordance with Kipnis & Hofstein (2007) that by arranging experiment plan students will be trained to develop their meta-cognition in making a planning and they also trained to think about every procedural as well as goal phases from each phase.

Research result shows that through implementation of problem solving learning model assisted by video recording can increase student cognition of memory, comprehension, application, analysis, evaluation, and creation. The video recording analysis using software tracker, where the analysis results are graph of position toward time and speed toward time, provide an opportunity to the student to interpret the graph and continued analysis. In this process the students try to apply their previous concepts and to evaluate the results, so that they can construct their knowledge, excavate the ideas related to the essential concepts. By

Table 3. Percentage of meta-cognition indicators of experiment and control group.

Meta-cognition Indicators	N-gain of Experiment Group (%)				N-gain of Control Group (%)			
	Kinematics	Criteria	Dynamics	Criteria	Kinematics	Criteria	Dynamics	Criteria
Declaration	59	moderate	68	moderate	53	moderate	67	moderate
Procedural	71	high	73	high	47	moderate	54	moderate
Conditional	70	moderate	65	moderate	44	moderate	64	moderate
Prediction	56	moderate	70	moderate	45	moderate	56	moderate
Planning	72	high	74	high	46	moderate	50	moderate
Monitoring	55	moderate	67	moderate	44	moderate	57	moderate
Evaluating	52	moderate	65	moderate	38	moderate	48	moderate

doing this activity the students ideas will appear and develop through process of continued thinking.

Problem solving learning using video recording shows positif impact in increasing the student cognition and meta-cognition. It is because through this model the students have a chance to conduct the investigation in solving the problem through experiment. The experiment using video recording analysis was done as follows. First, students were given opportunity to make prediction about solution of the problem they faced before conducting continued investigation through experiment. The prediction is supported by appropriate and deep physics concepts. Secondly, they try to answer the questions before conduct continued and appropriate investigation with problem that solved used appropriate physics concepts. The question intention to provide an opprtunity to the student in exploring theory to support the investigation. Thirdly, giving opportunity to the students to choose the equipment and material. Fourth, students conduct the plan of the experiment, equipment set up, determine the experiment steps, determine the variables measured, making the observation table. By gaining the data of the experiment, the students will have a chance to investigate the problem and to arrange the plan of experiment so that they can achieve knowledge and new experiences from their experiment results. Fifth, variables measurement is conducted according to what they plan previously. The variables is not written in the student worksheet to give freedom to the students to practice their ability to solve problem so that their ability in predicting and analyzing will be sharpen. Measurement in this experiment is conduct through video recording using software tracker. Sixth, the data of video recording were analyze using software tracker. The analysis results are graph of position toward time and speed toward time. Seventh, the students made appropriate conclusion with analysis results and then compared them with their previous prediction and answer of questions.

The research results are accordance to previous findings that through problem solving can increase concept mastery (Duch, Groh, & Allen, 2001; Akinoglu & Tandogan, 2007). Giving the problem will raise the students's curiosity and motivation to solve the problem so their concept mastery will increase as well (Fogarty, 1997). The finding is supported also by Tan (2003) who said that learning through problem solving can increase transfer concept to new situation, integration concept, intrinsic learning interest, and learning skill. This learning helps students to construct their knowledge and continued reasoning skill.

Problem solving learning using video recording demanded the students to evaluate the results whether they were appropriate to the theory as well as to consider the accuracy of analysis results. When the experiment was recording using video equipment and was analyzing using software tracker, the students can repeat the experiment if they make mistaken. While the students analyze those data, they can collect good part of the experiment results so it can help student conduct accurate inves-

tigation as well as analyze and give deep comprehension to them.

As already explained in the previous researches that the advantage of video usage in experiment activity are 1) can be used to investigate problem of real life situation with contextual concept; 2) freely accessed, picture per frame, and can be slowed down; 3) can be cutted and classified the part that will be used; 4) presenting moving thing in two dimension; 5) evaluation from this activity has potential to offer university level instructor and students the better way to visualize, investigate, analyze, and comprehend various topics in physics; 6) the video recording can be anlyzed easily so it can halp the students to construct and develop their comprehension (Tesee, 2007; Wagner, Altherr, Eckert, & Jodl, 2006; Zollman, 2001; Escalada & Zollman, 1997).

Based on analysis above, it can be conclude that through problem solving learning model, the students' cognition and meta-cognition can be build. It is supported by Foshay & Kirkey (2003) who said that problem solving model can influence learner cognition. They also stated that through problem solving learning model, students' cognitive that can be develop are: 1) explore knowledge that accordance to context, 2) find a solution of problem solving and develop plan to gain the goal, 3) apply the solution include doing what they plan and evaluate it. Tan (2004) noted that problem solving in learning process, plan of problem solution and the phase help learners to develop cognitive relation combination. By collecting data and information, learners need to apply analytic thinking ability, to compare and to classify the data. The learners will determine learning strategy, compare and share it to their peers to solve the problem. Awareness of self-thinking to direct, to compare, and to share learning strategy shows that the learners are involved in the learning activities. The idea is supported by Hollingword & McLoughlin (2002) who stated that meta-cognition ability, can guide the students to plan learning environment and choose strategy to fixed cognition performance in a future as ewll as to increase their learning results, especially their memorize ability and comprehension. Anderson & Nashon (2006) found that meta-cognition had by the students can increase learning capacity, support, and influence the students to construct their knowledge.

CONCLUSSION

It have been develop a physic learning model that suitable with physics characteristic, named problem solving learning model by using video recording. Based on limited try out test of model development in general physic learning, it can be concluded that implementation of problem solving learning model significantly resulted N-gain of cognition and meta-cognition in Kinematic and Dynamic particle topic in low category. The results show that implementation of problem solving learning model by using video recording is more effective to increase students' cognition and meta-cognition capability.

ACKNOWLEDGMENT

We are expressing our thanks to Dikti that given compete grand fund for the continuity of this research.

REFERENCES

AAPT. 2009. "*Building a stronger foundation in the knowledge and understanding of science*, *American Association of Physics Teacher".*

Akinoglu, O. & Tandogan, O. (2007). Effects of Problem-Based Active Learning in Science Education on Students' Academic Achievement, Attitude and Concept Learning. *Eurasia Journal of Mathematics, Science & Technologi Education,* 3 (1), 71-81.

Anderson, L. W. & Krathwohl, D. R. (eds). (2001). *A Taxonomy for Learning Teaching and Assessing*. A Revision of Bloom's Taxonomy of education Objectives. New York: Addisin Wesley.

Anderson, D. & Nashon, S. (2006). Predators of Knowledge Construction: Interpreting Students' Metacognition in an Amusement Park Physics Program. *Wiley InterScience*.

Arends, R. I. (2004). *Learning to Teach*. 5th Ed. Boston: McGraw Hill.

Costa, A.L. (ed). (1985). *Developing Minds, A Resource Book for Teaching Thinking*. Alexandria: ASCD.

Duch, B. J., Groh, S. E., & Allen, D. E. (2001). *The Power of Problem-based Learning*. Virginia: Stylus Publishing, LLC.

Escalada, L., & Zollman, D. A., (1997). An Investigation on the Effects of Using Interactive Digital Video in a Physics Classroom on Student Learning and Attitudes. *Journal of Research in Science Teaching*. 34, (5). 467–489.

Fogarty, R. (1997). *Problem-based Learning and Multiple Intelligences Classroom*, Melbourne: Hawker Brownlow Education.

Foshay, R. & Kirkley, J. (2003). *Principles for Teach-*

ing Problem Solving. PLATO Learning, Inc.

Gok, T. & Silay, I. (2008). Effects of Problem-Solving Strategies Teaching on The Problem Solving Attitudes of Cooperative Learning Groups in Physics Education. *Journal of Theory and Practice in Education*. 4 (2): 253-266.

Hake & Richard, R. (2002). *Relationship of Individual Student Normalized Learning Gains in Mechanics with Gender, High-School Physics, and Pretest Scores on Mathematics and Spatial Visualization*.

Heller, K., & Heller, P. (1999). *Problem-Solving Labs*. Introductory Physics I Mechanics. Cooperative Group Problem-Solving in Physics.

Hollingworth, R. & McLoughlin. (2002). *The Development of Metacognitive Skilss among Firts Year Science Student*.

Kipnis, M., & Hofstein, A. (2007). The Inquiry Laboratory as a Source for Development of Metacognitive Skilss. *International Journal of Science and Mathematics Education*.

Mariati, P.S. (2012). Pengembangan Model Pembelajaran Fisika Berbasis *Problem Solving* untuk Meningkatkan Kemampuan Metakognisi dan Pemahaman Konsep Mahasiswa, *Jurnal Pendidikan Fisika Indonesia* (JPFI), 8(2), 152-160.

Matlin, M. E. (2009). *Cognitive Psychology*. Seventh Edition. International Student Version. Jhon Wiley and Sons, Inc.

Schraw, G. & Moshman, D. (1995). *Metacognitive Theories*. Educational Psychology, Departement of Educational Psychology Papers and Publications.

Sheppard, K. & Robbins, D.M. 2009. The First Physics First Movement, 1880-1920. *The Physics Teacher*, 47, 46-50.

Setiawan, A. (2009). *Pemanfaatan Teknologi Informasi dan Komunikasi (TIK) dalam Pembelajaran Sains*. Materi Workshop dalam Kegiatan Pengabdian Masyarakat SPs UPI, Rabu 29 Juli 2009.

Selcuk, Calişkan, & Şahin, 2013, A Comparison of Achievement in Problem-Based, Strategic and Traditional Learning Classes in Physics, *International Journal on New Trends in Education and Their Implications* (Ijonte), 4(1), 154-164.

Tan, O. S. (2004). *Enhanching Thinking Problem Based Learning Approached.* Singapura: Thomson.

Tan, O. S. (2003). *Problem-based Learning Innovation*. Singapore: Thomson Learning.

Teese, R. (2007). *Video Analysis - A Multimedia Tool for Homework and Class Assignments*. 12th International Conference on Multimedia in Physics Teaching and Learning, 13-15 September 2007, Wroclaw, Poland.

Thiagarajan, S., Semmel, D. S., & Semmel, M. (1974). *Instructional Development for Training Teachers of Exceptional Children*. Source Book. Bloominton: Center for Innovation on Teaching the Handicapped.

Wagner A., Altherr, S., Eckert, B., and Jodl, H. J. (2006). Multimedia in physics education: a video for the quantitative analysis of the centrifugal force and the Coriolis force. *Eur. J. Phys*. 27 (2006) L27–L30.

Weinert, F.E., & Kluwe, R.E. (1987). *Metacognition, Motivation, and Understanding*. London: Lawrence Erbaum Associates.

Zollman, D. A. (2001). *Modeling Real World Events and Video Data Collection*.