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A GUIDED INQUIRY APPROACH-BASED PHYSICS PRACTICE MODEL TO IMPROVE STUDENTS' CRITICAL THINKING SKILL

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Abstract

This study aims to develop a guided inquiry approach-based physics practice model to improve students' critical thinking skills. This study refers to the research and development procedure model (R & D) by Borg and Gall. This study employs four phases namely specification, operationalisation, piloting, and revision. To get appropriate model, a try out was done based on five factors or steps which comprise (1) design, (2) subject of try out (research) (3) type of try out data, (4) instrumentt of data collection, and (5) technique of data analysis. The subjects of try out were 32 students which ware taken from the tenth grade student's of MAN 2 Mataram. The techniques of data collection in this study were validation sheets, observation sheets, questionnaires and tests, while the technique of data analysis using quantitative descriptive analysis. The model of being developed was analyzed by three (3) aspects, namely: validity, effectiveness, and practicality. The results of the validation of experts at 3.7 with a reliability of 96%, showing the developed model is valid. Based on the first trial, the implementation syntax developed model of the observer ratings obtained 97% done, it shows a model developed was practical. For N-Gain Student critical thinking skills after attending the learning physics practice models based guided inquiry 0.64 with moderate category, it demonstrates effective models developed for improving critical thinking skills. Based on the above results it can be concluded that the physics practice models based guided inquiry with a decent category.

Keywords: *Physics Practicum Model Based Guided Inquiry, Critical Thinking Skills*.

I. Introduction

Physics essentially could be viewed as a process and product. Therefore, learning physics should not rule out the discovery process concept. Physics as the process includes the skills and attitudes possessed by scientists to acquire and develop knowledge. Those are called science process skills. Physics as the product includes a set of knowledge consists of facts, concepts, and principles of physics. One of the methods that can be used to equip science process skills for students are practical methods, because of the practicum students can develop basic skills experiments. It became a means of achieving the orientation of science learning, which in addition to a product-oriented process-oriented as well. According Rustaman (2005), the lab was the best means to develop science process skills.

Learning with practical methods to give students the chance to experience for themselves or make their own. In general, lab work done at the school has not provided the experience for the student to make a hypothesis, test the truth of the hypothesis and analyze the data. This is due to the procedures used lab generally contains only direct instruction. Students are working on measures in accordance with instructions, so less practice thinking skills and science process skils. In addition, the lab activities that do not provide the opportunity for students to actively particte in an experiment to find the concept itself.

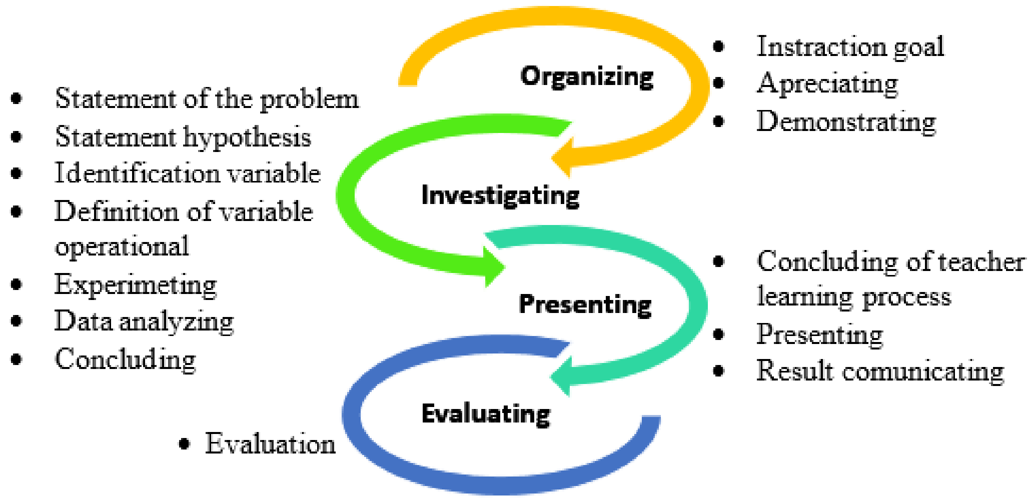
According Sumintono (2010) Other terms used to express the essence of science is science as a product for a replacement statement as a collection of knowledge ("a body of knowledge"), as a attitude to substitute statements as a means or way of thinking ("a way of thinking"), and as a replacement process for statement as a means of investigation (" a way of Investigating"). Physics is a part of science or science, then up to this stage can make the perception that the essence of physics are the same as the essence of science. The essence of physics is as a product, physics as an attitude, and physics as the process.

Based on an analysis by the West African Senior Secondary School Certificate in Negeria within a period of 10 years (1998-2007) that the physical science process skills are still low. This is seen in the acquisition value of the percentage of students' science process skills, namely: manipulating (17%); calculating (14%); recording (14%); observing (12%), and communicating (11%) (Akinyemi, O.A. &Folashade, A., 2010). Indonesia is also experiencing similar things, where research shows students' science process skills are still not encouraging. Here are the results of research by Nur (2011) showed that the average value of science process skills SMA Al Hikmah Surabaya such as: identifying a statement on observation (0.39), inference (0.42), prediction (0.43), classification (0.47), model (0.55), the hypothesis (0.54), identify independent variables of an experiment (0.40), and identify the dependent variables of an experiment (0.13); research Widiyanto (2009) showed that the acquisition value of the average percentage of science process skills of students of SMAN 3 Sragen, namely observation, classifying, predicting, inferring, identifying variables, create data tables, create graphs to analyze variables, construct hypotheses, measuring, and designing research by 48.66%. Low science process skills were in line with a lower critical thinking skills. This is reinforced by the pre-research ofBahtiar (2013) which resulted in the interpretation ability of students (40.47%), analysis (31.28%), Inference (37.21%). Later in the class X results of critical thinking skills that interpretation (38.55%), analysis (30.08%), Inference (35.10%). In a different school class X results of critical thinking skills that interpretation (40.47%), analysis (31.28%), Inference (37.21%). Based on these results indicate that the critical thinking skills of students is very low.

Concerning at the problems, above it is necessary to do a research on the development model that provides the opportunity for students to play an active role in the learning process and being able to practice the skills of high-level thinking skills. Research development is contained in the title "The model Development of guided inquiry-based physics lab work to improve critical thinking skills."

Physics practicemodels based guided inquiry is a model with a combination of practice conventional and guided inquiry aimed to train critical thinking skills. The learning physicspracticemodels based guided inquiry has four (4) syntax that is organizing, investigation, presentation and evaluation.

Figure 1 Syntax physics practice models based guided inquiry



This basic development is done based on the results of preliminary studies revealing that the critical thinking skills can be trained with science process skills, such as research by Nur (2008) in which science process skills are divided into two sections which carry out their respective roles, both are science process skills base and process skills applied. A study by Liliasari (2009) indicated that the critical thinking skills can be developed through the development of science process skills through inquiry learning. In line with the opinion of Lederman (2010), the study revealed that school science students' understanding of concepts and skills can be developed through the investigation and submission of scientific inquiry.

II. Research Methods

Development of physics practice models based guided inquiry using the R & D (Research and Development). Conceptually, the method of R & D by Borg et al. (2003: 570) includes 10 phases of activity, namely: (1) research and information gathering, (2) planning, (3) developing draft of the initial product, (4) the field testing early, (5) the revision of the initial product, (6) the main field testing, (7) product revision major field test results, (8) the field testing operations, (9) product revision field test results of operations, and (10) the implementation and dissemination. According to the needs in this study, then to adapt the 10 stages of the development research with attention to the essence of which must be met in the study. Adaptation to the 10 stages of the development of research resulted in three stages, namely: (1) a preliminary study, (2) product development, and (3) testing the product.

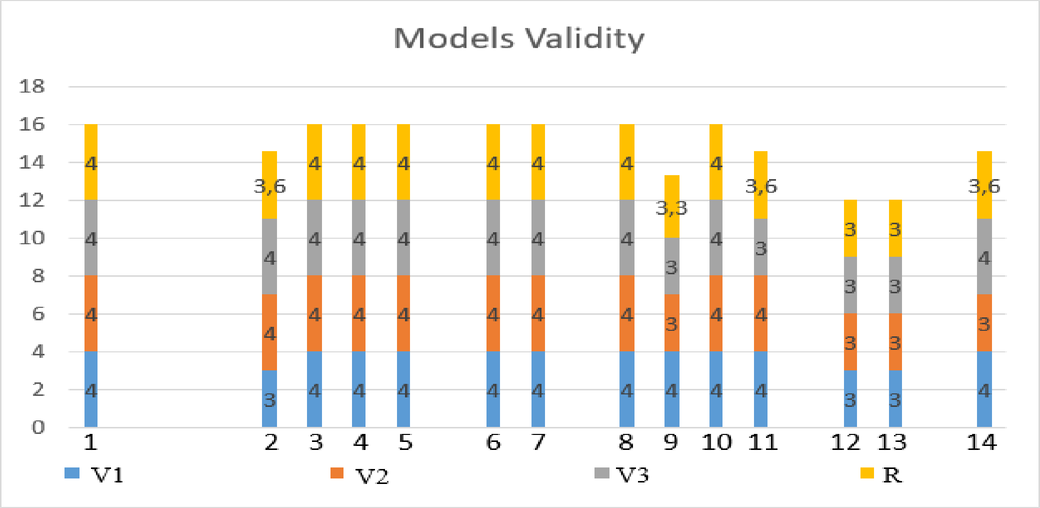
III. Results and Discussion

Physics practice models based guided inquiry was developed with the purpose of scientific experiments in the laboratory to see visually several science events in the actual event. Arend (2008) gives two reasons for using the term models. The first model has a broader meaning than the strategies, methods, or procedures. Second, the learning model can serve as an important means of communication, so classified based on learning goals, syntax (patterns of sequence), and the nature of the learning environment. According to Joyce, et al. (2009) the learning model in fact is just the same as the teaching model, because when teachers help students to acquire information, ideas, skills, values, and ways of thinking, they went to teach students about how to learn. The result of the development of this model addresses three requirements of a model that is said to be of high quality, which is valid, practical and effective. Sequentially it is described as follows:

Validity Model

These model validation activities undertaken to obtain comments and suggestions on the model developed, later revised as input validator. The results of the validation of the model can be seen in Figure 1, as follows:

Figure 1 Models Validity



Explanation:

1: Balance whit construtivisme principle
2 : Logic and Rational
3 : Sytacs can be aplyed
4 : Intraction
5 : Student centred
6 : Active
7 : Skills
8 : Positive atitude
9 : Flexibility
10 : Science intractions
11 : Traying critical thinking
12 : Aotentic example
13 : Rational thinking and objektives
14 : Problem solving
V1 : Validators 1
V2 : Validators 2
V3 : Validators 3
R : Average

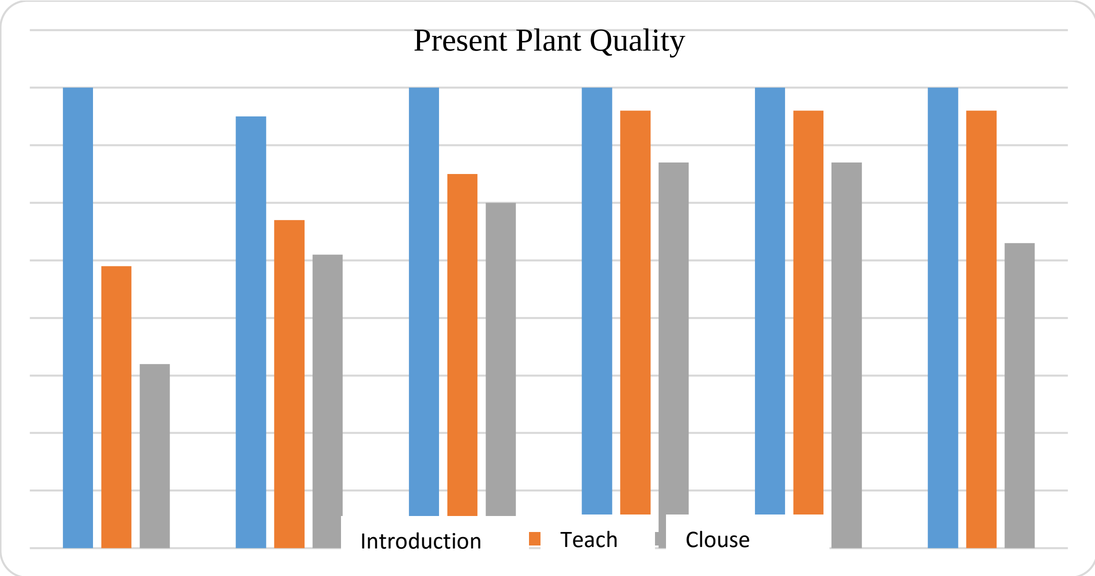
Based on Figure 1, the results of model validation physics practice models based guided inquiry depend on Borich (in Ibrahim, 2005) the third assessment validator determined realiabel when the average assessment of the three determined greater than or equal to 75%. The results of the third validation validator reliabelitas model developed by 96% thus three votes validator determined realiabel and models developed categorized valid based on empirical studies, namely the assessment of experts. The model developed also studied theoretically where the assessment model developed states worthy implemented to increase the skills of critical thinking. The theories used as the basis of the model are constructivism learning theory, cognitive learning theory, motivational theory, learning theory of information processing, scaffolding, and social constructivist learning theory.

The use of this model is supported by Sanjaya (2011) which states that the students' learning inquiry emphasis on the process of thinking critically and analytically to seek and find their own answer to the problem in question. According to Eggen and Kauchak (2012) inquiry gives students experience learning the scientific method, which is a pattern of thought that insists on asking questions, developing hypotheses to answer questions and test hypotheses with data. Further Eggen&Kauchak explained that the inquiry learning is designed to help students gain a deep understanding of the scientific method.

Practicality Model

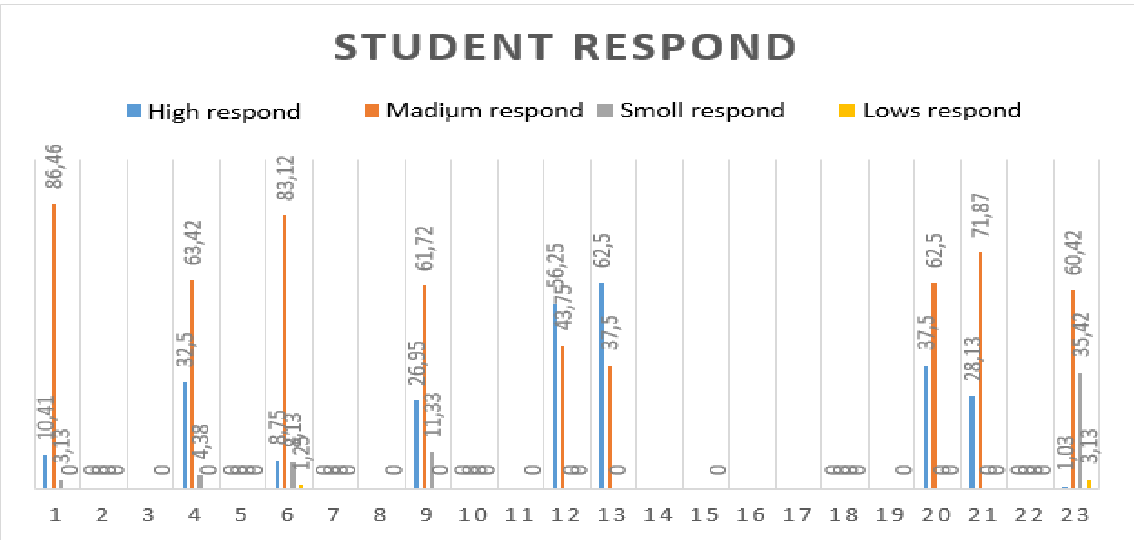
A model is practical if it can easily be implemented at each level of the school. Practicality model can be viewed from several aspects, including enforceability of lesson plan and the students' responses to learning with models developed. In detail recapitulation of implementation of lesson plan and student responses can be seen in Figure 2 below:

Figure 2 Present Plant Quality



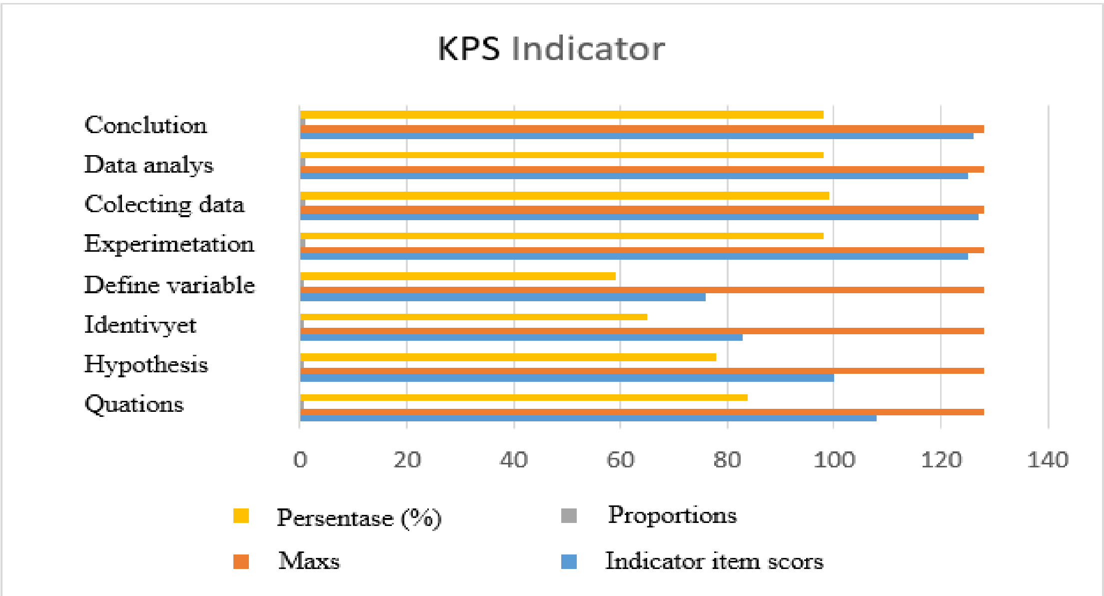
Based on Figure 2, the percentage of enforceability of learning goes well in accordance with lesson plans developed. The teachers were able to operate the learning device of preliminary activities until the end of activities and make students enthusiastic in particting in learning. For instrument reliability coefficient at each meeting is a meeting 1 = 91%, meeting 2 = 95%, meeting 3 = 100%, meeting 4 = 100%, meeting 5 = 100%, and meetings 6 = 100%. These instruments are categorized and can be used in learning activities because it has a reliability coefficient average of 96.85%. Observation sheet is categorized to be good if the average coefficient of reliability ≥0,70 (70%). (Borich, 1994).

Figure 3 Student Response



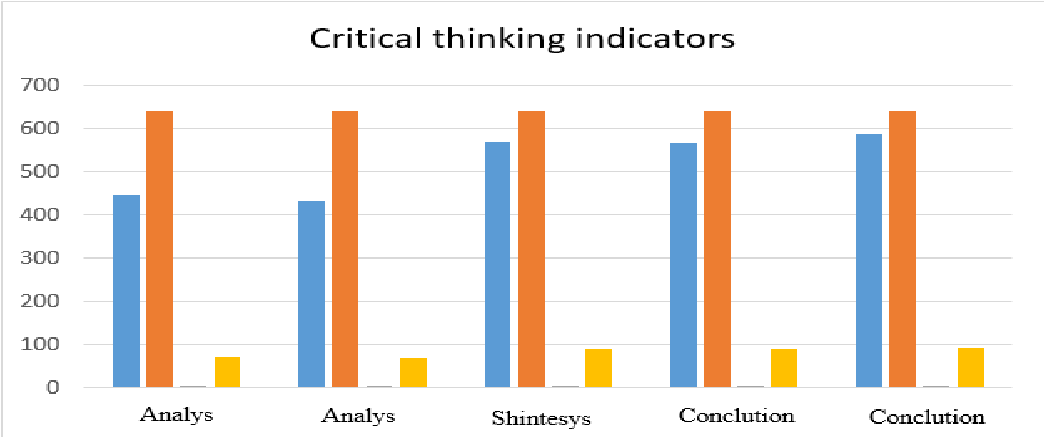
Based Figure 3, the students tend to respond positively to the learning practice physics models based guided inquiry. Some of the students (10.41%) are very interested in the components of the physics practice models based guided inquiry, and 86.46% of students are quite interested. Many students (32.50%) consider that learning with physics practice models based guided inquiry to improve students' critical thinking skills is something very new, and 63.42% considered quite new. Some other students (26.95%) consider that science process skills component in the exercise is something very new, and 61.72% of students consider fairly new. A lot of students (56.25%) are very interested in that physics practice models based guided inquiry can be applied to the subject of the next, while 43.75% of students interested enough. Most of the students (62.50%) are very interested in that study with physics practice models based guided inquiry can be applied to other subjects allied with physics, while 37.50% of students get interested in.

Figure 5 Science Process Skills



Based on grafic 5 obtained information that the learning physics practice models based guided inquiry can practice science process skills that students can complete the indicator with the percentage of completeness ≥60 based National Education Departement, 2008, except for the indicator number 4, namely, the ability of students defining operational variables.

Figure 6 Critical Thinking Indicators

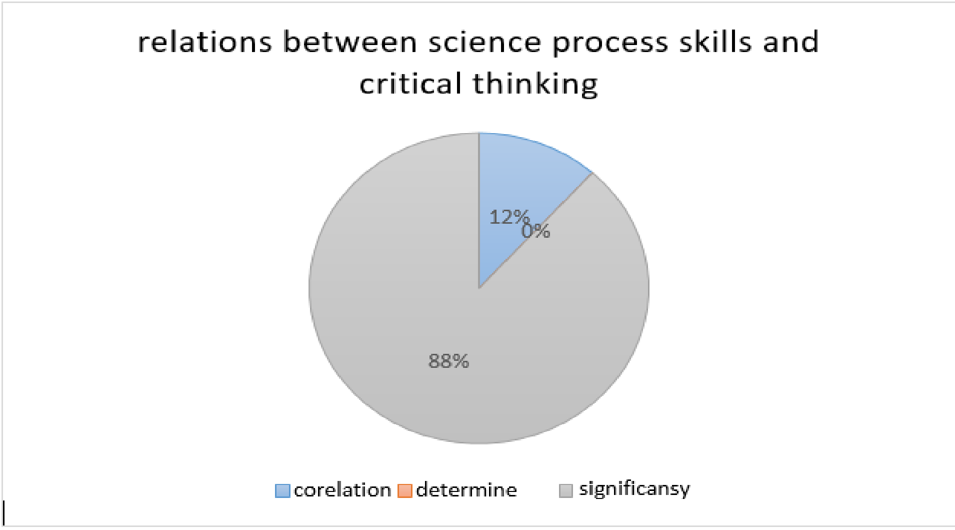


Based on Figure 6, it is known that the learning model guided inquiry-based physics lab can complete all indicators with a percentage of 81.13% completeness. Based on the criteria of National Education Departemen, (2008), it is determined that learning indicator completeness could be approved when it research percentage of ≥60%.

Critical thinking skills in this study, is drilled through the skill of the process. Critical thinking is the practice and development of a liveliness, curiosity, and the desired awareness of what is found in the classroom and in the outside world (John, 2010). Evaluating conclusion by examining the case, the evidence and the solution logically and systematically is critical (Woolfolk 2009). Azizmalayeri K. (2012), critical thinking skills include subscales such as inference, deduction and recognize assumptions, interpretation and evaluation of the argument. Components of critical thinking skills in the study include three indicators, namely the analysis, synthesis, and concluded.

The characteristics of critical thinking skills by Schafersman (1991) are in terms of knowledge, skills, attitudes, and habits of the act, namely: (1) using the facts skillfully and honestly, (2) organize thoughts and articulate them clearly, logically or reasonable, (3) to distinguish between conclusions based on logic that is valid with the logic that is not valid, (4) identify the adequacy of the data, (5) understand the difference between reasoning and rationalization, (6) tries to anticte the likely consequences of various activities , (7) understand the idea in accordance with the level of belief, (8) saw analogies and similarities are not superficial, (9) can learn independently and have a concern that cannot be lost in the work, (10) apply engineering problem solving in any other domain of she had learned, (11) can arrange representation disputes informally into a formal way as physics can be used to solve the problem, (12) may declare a verbal argument irrelevant and reveal arguments essential, (13) questioned the insights and questioned its implications from a view, (14) sensitive to the difference between the validity and the intensity of a belief in the validity and the intensity of the holding, (15) to realize that fact and understanding someone is always limited, a lot of facts which must be explained by the attitude of non-inquiry, and (16) erroneoug recognize the possibility of an opinion, may be in the opinion, and recognize the danger of the weighting of the facts according to personal choice.

Figure 7 Relation between Science Process Skills and Critical Thinking



Based on Figure 7 above, correlation science process skills on critical thinking skills have a positive relationship. These results can be seen in the table above where a correlation of 0.70 is considered to have a strong relationship. The data is backed up to the amount of the contribution or the determinant of science process skills on critical thinking skills as much as 71.25% with the high category. Based on parametric statistical tests of significance of the correlation to the percentage of error of 0.05 with degrees of freedom (db= n-2) obtained t of 5.30 while ttabel 2,042. The data indicates that a significant correlation or relationship.

Liliasari (2000) suggests that the influence of inquiry against ability critical thinking and the need to develop science learning for all through the inquiry model to make students learn critical thinking and decision making. Collette (1994) showed coherence build the basic ideas of science, the development of students' thinking from the concrete to the abstract.

IV. Conclusion

Based on the formulation of the problem and research objectives, it can be concluded as follows:

a. Physics practice models based guided inquiry is developed based on an assessment valid validator with a 96% level of reliability. Value supporting the validity of the theory, syntax, social systems, support systems, and instructional impact by an average of 3.7 in the category is very valid. Therefore, the model developed is feasible to implement in the school/ madrasah.
b. The learning activities with a physicspracticemodels based guided inquiry in improving critical thinking skills students achieve lesson plan activation percentage of 99.25%, observation of student activity achieve reliability of 94.03%. This is supported by the response of students to learning, in which the percentage of student interest to 100%. Other than that there are no obstacles to corner the implementation model developed, this means that the physics practicemodels based guided inquiry can be easily applied.
c. Critical thinking skills of students by a physics practice models based guided inquiry increase. It can be seen from the n-gain pre-test and posttest of 0.64 with moderate category. Thus the physics practicemodels based guided inquiry effectively can improve critical thinking skills. Based on the three conclusions, the model and learning tools developed is categorized valid, practical, and effective way to improve students' critical thinking skills

V. Referrences

Arends. (2008). *Learning to Teach. Book I. Seventh Edition. First Edition.* Yogyakarta. Student Library.

Arends, R. (2012). *Learning to Teach, 9th Edition.* New York: Mc-Graw Hill.

Akinyemi, O.A. &Folashade, A., (2010). *Analysis of Science Process Skills in West Africa Senior Secondary School Certificate Examination Practical Physics in Nigeria.* America-Eurasian scientific journal of reseach 5 (4), 234-240.

Bahtiar. (2013). *Preliminary Report of Study in Madrasah Aliyah Negeri (MAN) 1 Mataram, MAN 2 Mataram, and SMAN 2 Mataram.* NTB.

Bahtiar. (2015). *Book Series Instructional Materials: Science Teaching and Learning Strategies*. Mataram: CV Sanabil.

Borg, & Gall, M.D. (2001). *Educational Research.* Boston: Pearson Education, Inc.

Borich, G.D. (2006). *Teaching Strategies That Promote Thinking (Curriculum Models and Approaches).* Singapore: McGraw- Hill Education.

Collette, A. T., &Chiappetta, E. L. (1994). *Science instruction in the middle and secondary schools.* New York: Macmillan Publishing Company.

Based National Education Departement. (2006). *Regulation of the Minister of National Education 22, 2006: Content Standards.* Jakarta: National Education Standards.

Based National Education Departement. (2006). *Regulation of the Minister of National Education 23 of 2006 on Graduates Competency Standards for Primary and Secondary Education Unit.* Jakarta.

Eggen and Kauchak. (2012). *Educational Psychology: Windows on Classrooms, Student Value Edition (9th Edition).* Pearson

Paul and Kaucahak Don Eggen. (1996). *Strategy for Teachers.* Singapore: Allyn and Bacon.

Paul and Kaucahak Don Eggen. (2012). *Strategies and Models for Learning: Teaching Content and Thinking Skills, Issue 6 (Translation)*. Jakarta: PT. Index.

Ibrahim Muslimin. (2005). *Sustainable Assessment. Basic Concepts, Stages of Development and Examples.* Surabaya: UNESA University Press.

Ibrahim Muslimin. (2007). *Learning Inquiry.* (Online Article). http://kpicenter.org/index.php?option=com_content&task=view&id=37&Itemid=4. Accessed on May 2, 2013.

John, D. (2010). *Critical Thinking in an Online Word.* [On line]. Available: http://www.library.ucsb.edu/untangle/jones.html. [December 1, 2012].

Joyce, B., Weil, M. and Calhoun, E. (1992). *Models of Teaching.* New York: John Wiley and Son.

Joyce. B, Weil. M, & Calhoun, E. (2009). *Models of Teaching, Teaching Models. Indonesian edition.* Yogyakarta: Student Library.

Liliasari. (2009). *Critical Thinking in Science Learning Chemistry Towards Professionalism Guru.* Bandung: Education Studies Program Graduate School of UPI.

Rustaman et al., (2005). *Teaching and Learning Strategies Biology*. Malang: UM Press.

Schafersman, S. D. (1991). *Introduction to Critical Thinking.* [On line]. Available: http://www.freeinquiry.com/critical-thinking.html. [12 November 2012].

Sumintono, Bambang, et al., (2010). *Teaching Laboratory Science with Practice: Perspectives from Science Teachers SMPN in Cimahi.* Journal of Teaching Mathematics and Science, Volume 15, Number 2, October 2010. Hal.120-127.

Widiyanto. (2009). *Development Process and Comprehension Skills Class X through KIT Optics.* Indonesian Journal of Physics Education Vol.5 No. 1, 4-5

Woolfolk, A. (2010). *Educational Psychology, eleventh edition.* New York: Pearson.