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Developing Learning Model P3E to Improve Students' Critical Thinking Skills of Islamic Senior High School

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Abstract. This research aims to produce P3E learning model to improve students' critical thinking skills. The developed model is named P3E, consisting of 4 (four) stages namely; organization, inquiry, presentation, and evaluation. This development research refers to the development stage by *Kemp.* The design of the wide scale try-out used *pretest-posttest group design.* The wide scale try-out was conducted in grade X of 2016/2017 academic year. The analysis of the results of this development research inludes three aspects, namely: validity, practicality, and effectiveness of the model developed. The research results showed; (1) the P3E learning model was valid, according to experts with an average value of 3.7; (2) The completion of the syntax of the learning model developed obtained 98.09% and 94.39% for two schools based on the assessment of the observers. This shows that the developed model is practical to be implemented; (3) the developed model is effective for improving students' critical thinking skills, although the n-gain of the students' critical thinking skills was 0.54 with moderate category. Based on the results of the research above, it can be concluded that the developed P3E learning model is suitable to be used to improve students' critical thinking skills.

1. Introduction

Natural science is clasically divided into two parts, namely; (1) the physical sciences whose objects are matter, energy, and the transformation of matter and energy, (2) while the biological sciences whose objects are the living things and their environment [1]. As one branch of natural sciences, physics is the study of behavior and its control of nature in various forms of symptoms. Students' knowledge of science still need to be improved due to the fact that is still far from expectation.

The activeness in science learning lies in two things, namely physically active actions or hands-on and active thought or minds-on[2]. Both of these must be balanced, because being active physically is not enough, students also need to gain experience. Science learning is done by using various ways (techniques) such as observation, exploration, and experimentation. The standard competence of physics graduate in Senior High Schools requires the students to do experimentation, such as formulating problems, proposing and testing hypotheses, defining variables, designing and assembling instrument, collecting, processing and interpreting data, drawing conclusions, and communicating the results of the experiment in oral and in written forms. To meet these competencies, teachers are required to facilitate, motivate, direct, and guide students in practical activities and discovery.

Critical thinking skill is a skill that must be developed to face the 21st century. To support critical thinking, students must develop their process skills [4]. The development of science process skills

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allows students to construct and to solve problems and to do critical thinking [6]. This possibility can occur because most of the components of critical thinking are also the components of science process skills, such as; *observing, testing hypotheses, predicting, classifying, designing experiments, measuring,analysis, and synthesis*[7]. Critical thinking skills are considered to be the same as scientific thinking skills in science [8-10]. Therefore, critical thinking skills and science process skills need to be taught in science learning.

One of the learning models that can gain critical thinking skills is *inquiry* model [11], one of *inquiry* models that is able to arouse critical thinking skill is *guided inquiry*. According to [12]*guided inquiry* model can help students gain a better understanding, and students are more interested when they are actively involved. The acquisition of knowledge or concepts of physics in senior high schools should be fostered and developed through *inquiry* especially *guided inquiry* based on the students' curiosity [12]. The students are given the opportunity to solve problems through practical activities, and this model is suitable with the developmental level of students.

2. Research method

This research is a developmental research, where the subjects of this research were ten grader students in the 2016/2017 academic year. The topic that is taught were temperature and heat. The products of this research were syllabus, lesson plan, students' textbook, student worksheet and assessment sheet *(LP)* of the temperature and heat material integrated with P3E learning model. The development of this model was carried out through several stages, as follows.

2.1 Analysis Stage

This stage is to accommodate the needs *(needs assessment)* in the field. The needs analysis stage was reviewed through field study and literature study. Analysis of literature study consisted of; theoretical analysis supporting the learning model, syntax analysis, goal analysis, and learning environment analysis.

2.2 Design Stage

This stage was carried out in several steps, such as: the initial design of the learning model and the learning material by determining the focus on improving the critical thinking skills. The next was the validation of the model and the learning material the -i ($i \geq 1$) by experts. The revised results of the feedback from the experts were presented in *Focus groups discuss* (FGD). The objective of the FGD was to obtain input from three (3) validators of campus and ten (10) participants from various universities. The results of FGD were analyzed quantitatively and descriptively. The draft of the product that had been revised was then tried out (the-i, $i \geq 1$). The try out was only conducted on small populations. The technique sampling was done through *purposive random sampling.* The results of the try out analysis produced practical and effective learning model and learning material. If the results of the analysis were not practical and effective, they would be revised, and the learning model and the learning material were back to draft II-i, then tried out again the i-th (i = 1,2,3, ..., n) and analyzed, otherwise if the results of the analysis were practical and effective, it produced P3E learning model and learning material which were valid, practical, and effective.

2.3 Development Stage

The purpose of this stage was to know the improvement of students' critical thinking skills after using the products developed. The activity at this stage is called wide try-out. The samples were selected using *clustur random sampling* technique. The wide try-out was carried out for 6 meetings at the two *madrasah* (Islamic schools), namely MAN 1 grade XB and MAN 2 Model grade XC Mataram. Before the P3E model was applied, the researcher gave a pretest of critical thinking skill. After the pretest was carried out, the P3E learning model was implemented using valid and practical learning material. The posttest of critical thinking skill was given after the the learning process. The design of the try out and the wide try out of P3E learning model used *one-group pretest-posttest design,* as shown in Table 1.

Table 1. One group pretest posttest design

Pretest	*Treatment*	*Posttest*
O_1	X	**O_2**

Information:
O_1 : Pretest of critical thinking skills.
X : Treatment given to the students in the form of P3E learning model and the learning material developed.
O_2: Posttest of critical thinking skills.

[13].

The data about the students' responses were obtained through a questionnaire which was given at the end of the learning activity using P3E learning model. The validity of the data of the learning model and learning material were obtained by using validation sheet which was filled/assessed by the experts. The data of the implementation of learning model were obtained using observation technique by four observers. The data on the legibility and difficulty level of the textbooks and worksheets were obtained through *close procedure* technique while the difficulty level of the student textbook and student worksheets were done by highlighting the sentence which were not understood. The data of the students' responses were obtained through questionnaire method. The data of the obstacles encountered in the learning process were obtained through observation methods done by the observers. The data of science process skills were obtained through investigation activity *(LKS and LP)* performed by students which included eight indicators of science process skills. The data of critical thinking skills *(KBK)* were obtained through an essay test consisting of 5 questions. These questions were organized based on three (3) criterion of critical thinking skill indicators, namely: (1) analyzing, (2) synthesizing, and (3) concluding.

3. Result and Discussion

3.1 Result of Validity of P3E Learning Model

Table 2. Recapitulation of validation results

No	Component	Validation Score			Item Average	Category
		V1	V2	V3		
1	P3E Model	3.7	3.6	3.8	3.7	Valid
2	Lesson plan	4.41	4.76	4.90	4.70	Very Valid
3	Student worksheet	4.05	4.40	4.64	4.37	Very Valid
4	Textbooks	4.20	4.47	4.47	4.38	Very Valid
5	The assessment sheet	3.8	3.8	3.4	3.67	Valid
Average Validator Rating		4.03	4.21	4.24	4.16	Very Valid

Table 2 above shows that the result of the validation of the three validators for all components of the P3E model was 3.7 with valid category [14]. The table shows that the results of the expert study on the *items* of organization, investigation, presentation and evaluation have an average of 4.53 with a very valid category [14]. The achievement of this quality was because the development of the learning material had undergone through several stages, namely needs analysis, concept analysis, task analysis, discussion with MA physics teachers, and had been validated by experts (validator). The investigation component appeared on the content feasibility with an average value of 4.57 (very valid), the details are as follows; (1) fostering the ability to formulate problems (4.33 = very valid); (2) fostering the ability to formulate hypotheses (4.33 = very valid); (3) fostering the ability to identify variables (4.33 = very valid); (4) fostering the ability to define operational variable (DOV) (4.33 = very valid); (5) fostering the experimental activity (4.67 = very valid), (6) fostering the ability to collect experimental data (4.67 = very valid), (7) fostering the ability to analyzed data (4.67 = very valid) (8) fostering the ability to make conclusions on the results of the experiment (4,67 = very valid), thus the average component of student worksheet was 4.37 with very valid catagory [14]. The results of the validation of the student textbook from the three validators show that the average of the assessments from the

three validators for all components was 4.38 and the average value of each component was 4.0 <SV≤5,0. Thus, the category of each component as well as all the components were very valid [14]. The results of the validation of the assessment sheet of the students' critical thinking from the three validators were 1 question item which was determined as valid with revision, which was number 1, and 4 question items were determined as valid without revision. The assessment average was 3.67. The reliability of the assessment sheet based on the assessment from the validators was 94.44%, so that the assessment sheet was said to be reliable which was ≥0,75 (75%) [3]. The assessment sheet of critical thinking skills developed by researcher can be said to be valid to improve the students' critical thinking skills.

3.2 Results of the Effectiveness P3E learning model

The effectiveness of the P3E learning model could be seen from the achievement of the learning process after the implementation of P3E learning model, in which the achievement of the students of MAN 1 Mataram reached 93.10% with complete category, while the achievement of the students of MAN 2 Model Mataram reached 96, 77% with complete catagory. The average score of MAN 1 Mataram was 0.51 and the average score of MAN 2 Model Mataram was 0.47. Thus, the science process skills can be classically catagorized as complete. The research conducted by Nurex suggested that learning using science process skill approach can improve students' critical thinking skills by 71, 25% [15]. The research conducted by Haryono suggest that science process skilll based learning model is effective in improving students' science process skill from from 46.08% to 67.27% [15] . The result development students' post test science process skills in this research was greater than that of the pretest, and the students' learning outcomes were classically completed because they had the completeness of ≥85%. These results are presented in Table 3 and Table 4.

Table 3.The results of students' process skills

MAN 1 Mataram			MAN Model 2 Mataram		
Score		N-Gain	Score		N-Gain
Pretets	Postest		Pretest	Postest	
50.54	75.75	0.51	5 4.94	76.01	0.47
Completeness Percentage		93.10%			96.77%
Category		T			T

Table 4. The results of students' critical thinking skills

MAN 1 Mataram				MAN 2 Model Mataram			
Pre	**Post**	N-Gain	Category	Pre	Post	N-Gain	Category
61.21	**82,41**	0.50	S	62.10	82.42	0.53	S
Completeness Percentage		93.07%		Completeness Percentage		92.63%	

The N-gain of the critical thinking skills of the students of MAN 1 Mataram was 0.50 with medium category, and the N-gain of the critical thinking skills of the students of MAN 2 Model Mataram was 0,53 with medium category. Thus, it then can be said that the developed learning model was effective to improve critical thinking skills, although the N-Gain of the students' critical thinking skills in total was 0.54 moderate categoy.

Based on the results of the research and the theoretical study above, the students' understanding related to the critical thinking skill and science process skill can be improved. This is supported by the results of the research by Liliasari that science concept understanding can be imporoved through developing students' thinking skills [16]. In line with this, teachers feel easier to teach science to students whose critical thinking skills have been developed.

4. Conclusion

Based on the results and the discussion of the research,it can be concluded that: (1) the sophisticated P3E learning model is valid based on assessments from the validators. The validity score was viewed in terms of supporting theory, syntax, social systems, supporting systems, and instructional impact with an average of 3.7 with valid category. Therefore, the developed learning model can be implemented in schools, (2) The P3E learning model is practical to improve students' critical thinking skills. Based on the results of the completeness of the P3E learning model, each syntax has increased from the begining of the learning until the end of the learning with very good category. This is supported by the students' response toward the learning, with the accumulation of the students' interest reaching 100%. In addition, there is no any obstacle which cornered to the impementation of the developed P3E learning model, which means that the P3E learning model can be easily applied (practical), (3) the P3E learning model is effective to improve critical thinking skills, although the n-gain of the students' critical thinking skills with 0.54 with the moderate category.

Some suggestions are displayed as: (1) the implementation of the P3E learning model was only on the material of temperature and heat in grade X to improve students' critical thinking skills. It needs to be implemented more extensively on other physics materials and other science subjects, (2) he samples of the wide try out were only carried out in 2 schools. It is expected that other researchers increase the number of the research samples to strengthen the generalization of the research results, (3) ased on the results of n-gain, where it is still in the moderate category. Further in-depth study is expected to improve students' critical thinking skills through a structured exercise and the availability of adequate reference sources.

Further research is necessary to be conducted to analyze the effect of P3E learning model on the other variables, such as; thinking skills and problem solving skills

References

[1] Kemp 1994 *Instructional Design: A plan for unit and course development* (Belmont: Fearon-Pitman Pub)
[2] National Research Council (NRC) 2000 *Inquiry and the National Science Education Standards: A Guide for Teaching and Learning* [Online] http://books.nap.edu/html/inquiry_addendum/notice.html accessed 9 February 2013
[3] Depdiknas 2006 *Peraturan Menteri Pendidikan Nasional No. 23 tahun 2006* tentang Standar Kompetensi Lulusan untuk Satuan Pendidikan Dasar dan Menengah. Jakarta
[4] BSNP T 2006 *Standar Isi* (Jakarta: BadanStandar Nasional Pendidikan)
[5] Kalelioglu F & Gilbahar Y 2013 The Effect of Instructional Techniques on Critical Thinking and Critical Thinking Disposition in Online Discussion *Education Technology & Society* **17**(1) 248-258
[6] Kemble 1999 *National Academy of Science* (Washington DC: National Academies Press)
[7] Hassard J 2005 *The Art Teaching Science* (New York: Oxford University Press)
[8] Ergazaki M 2000 Biotechnology/Genetic Engineering *Research on Teaching and Learning in Critical Thinking Context* http://www.iubs.org/patras.biotech-criticalthinking.pdf access pada 18 Desember 2015.
[9] Pomahac G, Thelma M Gunn, Lance M Grigget 2007 Bioethics and Critical Thinking in a Science Classroom *Conference Prisiding* http://www.umanitoba.ca/confer-guy.1438.pdf accessed 18 Desember 2015
[10] Schafersman S D 1991 *Introduction to Critical Thinking* [Online] http://www.freeinquiry.com/critical-thinking.html accessed 12 November 2012
[11] Eggen Paul and Kaucahak Don 2012 *Strategi dan Model Pembelajaran: Mengajar Konten dan Keterampilan Berpikir, Edisi 6* (Jakarta: PT. Indeks)
[12] Nur M 2011 *Teori-Teori Belajar* (Surabaya: Universitas Negeri Surabaya)
[13] Arikunto Suharsimi 2006 *Dasar-Dasar Evaluasi Pendidikan* (Jakarta: Bumi Aksara)

[14] Ratumanan T G dan Laurens 2006 *Evaluasi Hasil Belajar Yang Relevan Dengan Kurikulum Berbasis Kompetensi* (Surabaya: Unesa University Press)
[15] Nur M 2011 Hasil-Hasil Penelitian dan Pengembangan Perangkat Pembelajaran bermuatan Keterampilan Berpikir dan Perilaku Berkarakter Pendukung Pendidikan IPA Bertaraf Internasional *paper presented in Seminar Nasional Pendidikan MIPA Universitas Negeri Sriwijaya* 17 September 2011
[16] Liliasari 2009 *Berpikir Kritis dalam Pembelajaran Sains Kimia Menuju Profesionalitas Guru* (Bandung: Program Studi Pendidikan IPA Sekolah Pascasarjana UPI)