

The improvement of students physics problem

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The improvement of students physics problem solving skills through the implementation of PO2E2W learning model assisted PhET media

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Abstract. The purpose of this research was to improve students' physics problem solving skills through the implementation of PO2E2W learning model assisted PhET media on physics learning. This research used one group pre-test and post-test design at 64 students academic year 2017/2018. Students physics problem solving skills were measured by using Problem Solving Skills Assessment Sheet (PSSAS). Data analysis technique used Paired t-test, n-gain, and Independent t-test. The result of this research proved that: (1) there was improvement of student physics problem solving skill at $\alpha = 5\%$, (2) average score of n-gain physics problem solving skill 0.81 (high category), (3) there was no difference (consistency) n-gain students physics problem solving skills in all groups, and (4) students response were very positive toward the implementation of PO2E2W learning model assisted PhET media. Therefore the PO2E2W learning model assisted PhET media had been proven to be effective in improving the physics problem solving skills of senior high school students. The implication of PO2E2W learning model with PhET media study can be used as a solution to improve physics problem solving skills of senior high school students.

1. Introduction

The 21st century has just been running for a decade, but in the world of education, there has been a shift, and even a fundamental change in philosophy, its direction and its goals. It is no exaggeration to say that the progress of science is triggered by the advancement of science and computer technology. In the context of the utilization of information and communication technology, education world has proved to be more narrow and merging factor of space and time which has been the determinant aspect of speed and success of mastery of science by mankind. The problems which has been facing human in the 21st century are increasingly complex, interlocking hooks, rapidly changing and full of paradoxes. Generally, the futurists attribute the rapidly growing population of the world as a trigger. If in 2010 the world population is 6.9 billion, then, in 2050, the United Nations Population Division estimate at 9.2 billion people on world population. This means that, within forty years, there will be an increase of 2.5 billion inhabitants. The impacts of this growth on all human life are remarkable, ranging from survival, food,



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health, welfare, security and education issues [1]. In facing the challenges of the 21st century, one of the skills needed is problem solving skills. Someone who has problem solving skills can easily solve the problems that arise in his life. In addition, problem solving skills are needed in all professions and determine one's success in the future. A person who has problem solving skills will be more creative in thinking, having critical thinking skills in analyzing data, facts and information, and more independently in acting and working [2-3]. According to [4], the problem is a situation, quantitative or otherwise, faced by individuals or groups of individuals in need of solution.

Based on the results of preliminary study of problem solving skills on the material of kinetic theory of gas, especially the ideal gas law in class XII IPA 5 which amounted to 15 students at SMA Kemala Bhayangkari 1 Surabaya, the results obtained included: (1) improper understanding of problems related to ideal gas law (54.35%), (2) inappropriate in planning problem solving related to ideal gas law (56.52%), (3) improper in conducting problem solving plan related to ideal gas law (67.39%) and (4) incorrect in re-checking from problem solving related with ideal gas law (32.61%). Based on the results of these preliminary studies, it was necessary to have an effective learning model from which the student may improve their problem solving skills. Previous research [5] suggest that the use of developing a self-regulated learning PO2E2W learning model can improve students' problem solving skills on caloric materials in junior high. This was because the PO2E2W learning model has the following characteristics: (1) PO2E2W learning model is oriented to self-regulated learning from which, in each phase of activity, the students is guided in problem solving [5], (2) PO2E2W learning model has a characteristic of cooperative and collaborative works reflected in several phases in the PO2E2W learning model, although the learning model is oriented to self-regulated learning, but according to research results [6,18] suggests that collaborative work and small groups may develop self-regulated learning in various activities such as playing or problem solving, (3) The PO2E2W learning model has a phase of elaboration and write in science which is a phase of repetition of the problem orientation, observation and explanation phases that aim to enable the learning process to access the long term memory [5]. This stage is supported by the theory of information processing that explains processing, storage and retrieval of knowledge from the brain [8].

Based on the results of the study [5], it requires the improvement of the PO2E2W learning model for example from the aspect of a more varied learning media such as interactive multimedia [5]. So in this research want to use PO2E2W learning model which media assisted that is PhET media, such that it hopefully can improve effectively the students problem solving skill and challenge in facing 21st century about technological development. PhET media is a software simulation medium that can be used in physics learning both in online and offline state. PhET media is perfect for overcoming some abstract physics material. The use of PhET media in the process of learning activities is very suitable for senior high school students because senior high school students of category 17-19 years old students can already think abstractly [9]. This is supported based on the results of the study [10] which states that learning with the help of virtual media influences the ability of physics problem solving learners. In addition, based on the results of research [11], the PhET media assisted learning can improve the ability of high level thinking and responsibility students of class XI IPA on the material of kinetic theory of gas. The focus of this study is a follow-up study based on recommendations [5] to see the effectiveness of the PO2E2W learning model with PhET assisted media to improve the problem solving skills of high school students. The results of this study are expected to be an empirical evidence that the learning model of PO2E2W with PhET assisted media can improve the problem solving skills of senior high school students in physics learning.

3 Method

3.1 General Background of Research

The research was conducted at SMA Kemala Bhayangkari 1 (Surabaya, Indonesia). Scope of this research is senior high school students of class XI IPA 2 and XI IPA 3 who take physics year 2017/2018 academic year. The objective was to analyze the effectiveness of PhET media which was used for helping the implementation of the PO2E2W learning model. This study was analyzing the improvement

of physics problem solving skills of senior high school students before and after using PO2E2W learning model with using PhET media as the assistant. The effectiveness of PO2E2W learning model using PhET media was determined based on: (1) there was improvement of students physics problem solving skills at $\alpha = 5\%$, (2) average score of n-gain students physics problem solving skills 0.81 (high category), (3) there was no difference (consistency) n-gain students physics problem solving skills in all groups, and (4) students response were very positive toward the implementation of PO2E2W learning model assisted PhET media.

2.2 Sample of Research

The samples were 64 students at SMA Kemala Bhayangkari 1 (Surabaya, Indonesia) using purposive sampling technique in two groups: group 1 (class XI IPA 2) and group 2 (class XI IPA 3) had homogeneity of physics problem solving skills. Each group consisted of students on physics subjects in the academic year 2017/2018.

2.3 Instrument and Procedures

Problem solving skills in Physics of senior high school students was measured using the Science Problem Solving Skills Assessment Sheet (SPSSAS), which had been declared valid and reliable. SPSSAS was prepared based on the measured physics problem solving indicator that was: (1) understand the problem, (2) plan problem solving, (3) do problem solving plan, (4) do check back from troubleshooting result [12]. Physics lesson materials used in this study were selected in accordance with the characteristics of PO2E2W learning model assisted PhET media, namely the kinetic theory of gas. This study used one group pre-test and post-test design, O1 X O2 [13]. The learning process was begun giving pre-test (O1). Every senior high school student subjects was required to complete SPSSAS. After the pre-test, the teacher applied PO2E2W learning model and Physics learning device in each group (X). The implementation of the PO2E2W learning model had been conducted for five meetings on Physics subjects. Physics Learning used the PO2E2W learning model assisted PhET media with five syntaxes: (1) problem orientation, (2) observation, (3) explanation, (4) elaboration, and (5) Write in science. Physics learning tools consisted of: syllabus, learning implementation plan, student activity sheet, textbook, SPSSAS and students' response questionnaire (valid and reliable) [14]. After the implementation of the PO2E2W learning model assisted PhET media was ended with post-test (O2) using SPSSAS. Every senior high school student subjects was required to complete SPSSAS on post-test.

2.4 Data analysis

Physics problem solving skills of senior high school students were analyzed based on the assessment determined before and after using the PhET media to assist the implementation of the PO2E2W learning model of learning. Pre-test, post-test, and n-gain problem solving skills of senior high school physics physicists were analyzed using inferential statistics with the help of SPSS software. n-gain is determined using the equation: $n\text{-gain} = (\text{maximum score} - \text{pre-test score})$ [15], with criteria: (1) if $n\text{-gain} \geq 0.7$ (high), (2) if $0.3 < n\text{-gain} < 0.7$ (moderate) and (3) if $n\text{-gain} \leq 0.3$ (low) [15]. The choice of statistical testing methods depends on fulfilling the assumptions of normality and homogeneity of variants for pre-test, post-test, and n-gain problem solving skills of senior high school students physics. Inferential statistical tests with Paired t-test (analysis of statistical improvement) and n-gain consistency analysis of all senior high school students groups was done using Independent t-test. The students responses were analyzed using quantitative descriptive technique with the percentage of students response = $((\text{total number of students who voted} / \text{total students}) \times 100\%)$, with criteria: (1) 76%-100% (very positive), (2) 51% -75% (positive), (3) 26%-50% (less positive), and (4) 0%-25% (not positive) [16].

3. Result and Discussion

The results are presented in Table 1, Table 2, Table 3, Table 4 and Figure 1 which will be explained as follows.

Table 1. The average value of pre-test, post-test and n-gain physics problem solving skills of senior high school students.

Group	Physics problem solving skills of senior high school students					
	Pre-test		Post-test		N-gain	
1 (Class XI IPA 2)	31.70	Low	86.44	High	0.80	High
2 (Class XI IPA 3)	28.24	Low	86.94	High	0.82	High

Table 1 described the mean of pre-test, post-test and n-gain physics problem solving skills of senior high school students. The low pre-test value was due to the students not yet having problem solving skills. According to Piaget [6], the process of adaptation can be through the process of assimilation and accommodation. The process of assimilation means that if students gain new knowledge or experience, then the new experience fits the scheme. While the accommodation process is the process of adaptation that occurs if students gain new knowledge, then the students change the schemes to be in accordance with the new knowledge. During the adaptation process, students interest in learning using PO2E2W model used PhET media, so that students' physics problem solving skills can be improved. This claim is supported by the n-gain class IX IPA 2 and class XI IPA 3 which is considered as high category, which meant pre-test and post-test values were increasing in both groups. The results of this implementation PO2E2W learning model PO2E2W was assisted PhET media study was proved to be effective in improving the physics problem solving skills of high school students. This was because the developed PO2E2W learning model has met the validity (content and construct), the practicality, and the effectiveness of improving the physics problem solving skills of senior high school students [14]. This was supported by the results of the study [5] that the PO2E2W learning model is feasible to meet the validity (content and construct), practicality, and effectiveness will be able to improve and achieve the learning objectives of improving students' physics problem solving skills. Normality test results and homogeneity of variance suggested that the pre-test, post-test, and n-gain students physics problem solving skills were homogeneous and normally distributed for the whole group. Therefore, the impact of implementing the PO2E2W learning model on improving students' physics problem solving skills for all groups can be elicited by using Paired t-test and consistency test using Independent t-test. Paired t-test and Independent t-test results are presented in Table 2 and Table 3.

Table 2. Result of Paired t-test physics problem solving skills for all groups.

Group	N	Paired t-test, $\alpha = 5\%$			
		Mean	t	df	P
Group-1	32	-5.474	-66.135	31	.00
Group-2	32	-5.870	-93.903	31	.00

Table 2 showed the values of $t = -66.135$ and -93.903 for degrees of freedom (df) = 31 (group-1 and group-2). Each score was considered significant because $p < 5\%$. Therefore, the results of the calculations were negative, thus indicating there was an improvement in students' physics problem solving skills after the implementation PO2E2W learning model assisted PhET media for all groups.

Table 3. Result of Independent t-test physics problem solving skills for all groups.

Independent t-test, $\alpha = 5\%$			t	df	Sig. (2-tailed)
N-gain	Group-1	Group-2	-1.473	62	0.146

Table 3 showed that t arithmetic gives $t < t$ table with significance level $P > 5\%$. This showed clearly that there was no difference in the improvement of students physics Problem solving skills after the implementation PO2E2W learning model assisted PhET media for all groups. Based on the results in Table 2 and Table 3, it had been shown that the results of improving students physics problem solving skills and outcomes for all groups had no significant differences (the existence of consistency) of students physics problem solving problem skills from the impact of the implementation of PO2E2W learning model assisted PhET media for all groups had been developed to improve students problem solving skills through syntax of problem orientation, observation, explanation, elaboration, and write in science. The results were reinforced with theoretical and empirical support that the PO2E2W learning model is an effective self-regulated learning oriented for improving students' problem solving skills [5] supported by learning theories, namely behavioral theory, social cognitive theory, constructivism theory and information processing theory [18-20]. This was supported by the results of the study [2-21] that the models, media, methods, instruments that are eligible for their validity, practicality and effectiveness will be able to improve and achieve learning objectives. Therefore, the PO2E2W learning model assisted PhET media is effective for improving the physics problem solving skills of senior high school students. The improvement of students physics problem solving skills reinforced qualitative data presented in Figure 1.

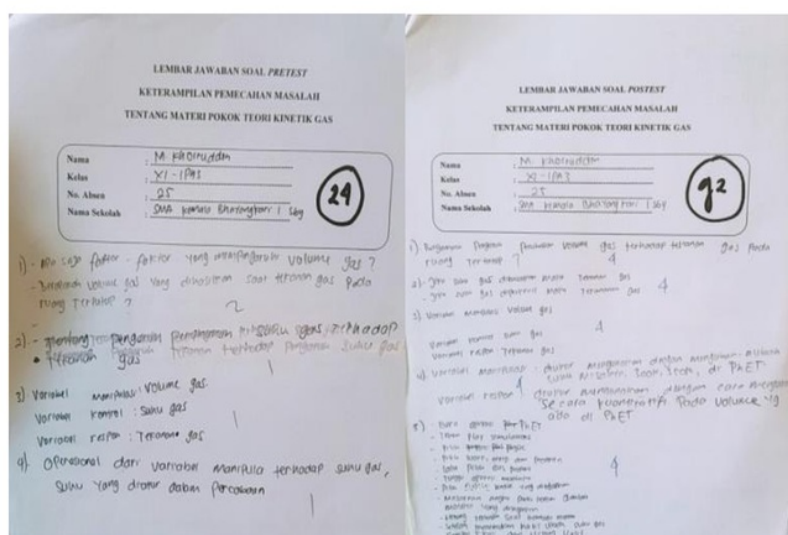


Figure 1. Differences of students physics problem solving skills before and after implementation of PO2E2W learning model assisted PhET media.

Based on Figure 1 explained that the students pre-test value is 24. This value was low. This showed that students problem solving skills were still very low. After the students got the learning by using PO2E2W learning model assisted PhET media, students' problem solving skills had been improved, marked with high post-test value that was 92. In the pre-test sheet, it can be seen that the students had not understood in answering the problem related to the indicators of problem solving skills on kinetic theory of gas material. For example, in question number 1 pre-test, students could not understand the problem to be able to formulate the problem by answering what are the factors affecting the volume of gas. The students also answered what is the volume of gas produced when gas pressure in the closed room so that the students instead of only got score 2 points from question number 1 that was the

question answered and the answer was in question but still wrong in formulating the problem. After the students were given the treatment of implementing learning by using the PO2E2W learning model assisted PhET media, the students understood better the problem in post-test about the number 1 by being able to formulate the problem correctly. Based on the pre-test and post-test results, it can be seen that the students had reached the indicator problem solving skills. In this process, the students were given learning with the PO2E2W learning model assisted PhET media. The students adapted toward the learning model several learning meetings until students learning interest emerging and can improve student physics problem solving skills. Improvement of students' problem solving skills were supported by the PO2E2W learning model assisted PhET media model instrument in each phase of self-regulated learning oriented activities [14]. Besides, it was also based on the results of the study [22,23] suggesting that problem solving relates to self-regulated learning and requires scaffolding. Other research results [24, 25] suggest that groups who were given self-regulated learning training achieved higher academic achievement than the group who do not have self-regulated learning training. The improvement of the students physics problem solving skills after implementation PO2E2W learning model assisted PhET media supported by student response data presented in Table 4.

Table 4. Senior high school students response to PO2E2W learning model assisted PhET media

Group I (Class XI IPA 2)			Group II (Class XI IPA 3)		
Sample	Response	Category	Sample	Response	Category
32	90.11%	very positive	32	91.14%	very positive

Table 4 showed that in general the students response was very positive toward the learning of the PO2E2W learning model assisted PhET media. Interview results showed that students feel the problem solving skills of physics increases. The results of this study became an empirical evidence of the effectiveness of PO2E2W learning model assisted PhET media to improve the skills of senior high school students problem solving.

4. Conclusion

The learning model of PO2E2W (problem orientation, observation, explanation, elaboration, and write in science) assisted PhET media was a self-regulated learning model in which its process of physics learning activities is carried out with the help of PhET media. The result of this study proved that: (1) There was improvement of students physics problem solving skills at $\alpha = 5\%$, (2) Average score of n-gain of student physics problem solving skills was 0.81 (high category), (3) there was no difference (consistency) n-gain significant physics problem solving skills in all groups and (4) students' responses were very positive toward the implementation of PO2E2W learning model assisted PhET media. Therefore, the PO2E2W learning model assisted PhET media had been proven to be effective in improving the physics problem solving skills of senior high school students. The implications of this research were as an alternative in improving the physics problem solving skills of senior high school students in Indonesia. Further research needs to replicate PO2E2W learning model assisted PhET media in improving students' physics problem solving skills at various levels.

References

- [1] BSNP 2010 *Paradigma pendidikan nasional abad XXI* (Jakarta: Badan Standar Nasional Pendidikan)
- [2] Sunarti T, Wasis, Madlazim, Suyidnoand, and Prahani B K 2018 *J. Phys: Conf. Ser.* **997** 012013
- [3] Limatahu I, Suyatno, Wasis and Prahani B K 2018 *J. Phys: Conf. Ser.* **997** 012022

- [4] Krulik Sand Rudnick J A 1996 *The new sourcebook for teaching reasoning and problem solving in junior and senior high school* (Boston: Allyn and Bacon)
- [5] Odja A H 2017 *Disertasi* (Surabaya: Pascasarjana Unesa)
- [6] Iiskana, Tuike, Vaurus, and Marjaand L E 2004 *Journal of Psychology* **1** 147
- [7] Whitebread, David, Bingham, Sue, Grau, Valeska, Pasternak, Deborah P, and Sangster, C 2017 *Journal of Cognitive Education and Psychology* **6** 433
- [8] Trianto 2007 *Model pembelajaran terpadu dalam teori dan praktik* (Jakarta: Prestasi Pustaka)
- [9] Bulu S T and Pedersen S 2010 *Education Teaching Research* 507
- [10] Hastuti A, Sahidu H, and Gunawan 2016 *Jurnal Pendidikan Fisika dan Teknologi* **23**
- [11] Afifah R, Masjikur K, and Sutarman 2014 *Jurnal Universitas Negeri Malang* **2** 1
- [12] Polya G 1957 *How to solve it: An new aspect of mathematical method* (New York: Doubleday & Company, Inc)
- [13] Fraenkel J R, Wallen N E, and Hyun H H 2012 *How to design and evaluate research in education* (8thed.) (New York: McGraw-Hill)
- [14] Sari A S D 2018 *Makalah Komprehensif* (Surabaya: Pascasarjana Unesa)
- [15] Hake R R 1998 *Am. J. Phys.* **66** 64
- [16] Riduwan 2012 *Skala Pengukuran Variabel-Variabel Penelitian* (Bandung: Alfabeta)
- [17] Lefrancois G R 2000 *Theories of human learning* (Belmont: Cengage Learning)
- [18] Moreno R 2010 *Educational psychology* (New York: John Wiley and Sons Inc)
- [19] Arends R I 2012 *Learning to teach* (New York: Mc. Graw-Hill Companies)
- [20] Slavin ER 2011 *Educational psychology: Theory and practice* (Boston: Pearson)
- [21] Suyidno, Nur M, Yuanita L and Prahani B K 2017 *J. Res. Method. Educ.* **7** 56
- [22] Bulu S T and Pedersen S 2010 *Education Teaching Research* 507
- [23] GeX, and Land S M 2004 *Educational Technology Research & Development* **5** 22
- [24] Fasikhah S M and Fatimah S 2013 *Sci. J. App. Psych.* **1** 145
- [25] Al-Rawahi N M and Al-Balushi S M 2015 *I. J. Environmental Sci. Educ.* **10** 367

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