Developing Critical Thinking, Scientific Attitude, and Self-efficacy in Students through Project Based Learning and Authentic Assessment in Science Teaching at Junior High School

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Abstract. The aim of this study was to analyze the effect of Project Based Learning (PjBL) model on critical thinking, scientific attitude, and self-efficacy in students. This study used a quasi-experiment of post-test only control group design. The subjects were 60 ninth grade students of public high schools in Singaraja in the academic year 2017/2018 selected randomly from the existing classes, in which 30 students were assigned to the experiment class and another 30 to the control class. The instruments used were critical thinking test, scientific attitude questionnaire, and self-efficacy questionnaire. The instruments had a high reliability. The data were analyzed descriptively and to test the hypothesis, MANOVA with the 5% significance level was used. The result showed that simultaneously critical thinking, scientific thinking, scientific attitude, and self-efficacy of the students who learned with PjBL and authentic assessment significantly differed from those who learned with PjBL and conventional assessment (F=10.79; p<0.05). The group of students who learned with PjBL and authentic assessment had a high mean than that of those who learned with PjBL and conventional assessment. In other words, authentic assessment is effective in enhancing critical thinking, scientific attitude, and self-efficacy of the students in science teaching.

Keywords: Project based learning; Authentic assessment; Critical thinking; Scientific attitude; Self-efficacy.

1. Introduction

In this era of industry revolution 4.0, challenges in quality in various aspects of life can no longer be bargained. To meet the challenges of the future which are increasingly complex, five minds of the future are required which consist of disciplined mind, synthesized mind, creating mind, respecting mind, and ethical mind [1]. Furthermore, the challenges of the future must be met by developing creativity and entrepreneurship through national education transformative critical pedagogy [2]. Hence, that which has to be prepared for human resources for the future is their thinking ability. Hence, today’s education has to be oriented toward the enhancement of the nation’s competitive advantage to be able to compete in the global competition. This can be reached if education at school is oriented not only toward the acquisition and understanding of scientific concepts, but also toward the enhancement of the student’s ability and skill in critical thinking, especially in high order thinking.
skill or critical thinking skill. It means that the teacher needs to facilitate the students to learn how to think, especially high order thinking.

Science education has a great potential in developing the students’ high order thinking ability. In addition to learn in the science products, in the form of facts, concepts, principles, laws, and theories, science education also develops scientific attitude and the students’ thinking skill [3,4]. Various efforts have been made by the government in relation to quality human resources development, for example, improving teachers’ quality, providing learning facilities, developing competence based curriculum, and implementing integrated quality management. However, the efforts have not yet seemed to show any optimal results. The results of research and evaluations showed that, first, from Trend International Mathematics Science (TIMSS) in 2011 report on the mean scores in science in the cognitive domain, which is an important aspect in problem solving ability. Indonesia ranked 45 of 48 nations in the world with the score in science of 397 [5]. Another result that is related to the pattern of thinking of the contemporary society is the social problems that have been occurring in Indonesia, such as shown in the printed media, television, and other social media that are related to the provocation and slanders and libels through hoaxes which can destroy the social order of the nation which are divisive among the Indonesian. These are suspected due to the low critical thinking ability of the people in reacting to the hoaxes so that the unity of the Republic of Indonesia is endangered. The critical thinking skill of the students of public high schools in Bali Province is still low. This has been caused by the dominance of the teachers in the instructional process who have not given an opportunity to the students to develop autonomously through their discoveries and thinking processes [6]. On the basis of the explanation, then in the science teaching it is expected that the students get meaningful experiences to develop thinking abilities. The students’ still low scientific achievement in science teaching, especially in physics has been caused by the density of the material and the standard of success of education at school which still focuses on products (concepts), thus, the implementation of physics teaching, especially the scientific performance, is very minimal. On the basis of the explanation above, it seems that the low critical thinking skill and scientific performance of the students in science teaching tends to be due to the less than optimal teaching implementation.

On the basis of the gap that has been described above, then there is a need to improve the teaching process, both in relation to the process of assessment, and the model of teaching which should be more innovative and capable of developing scientific performances and critical thinking skills of the students. One of the teaching models which does not only empower science as product but also science as process, especially for improving the students’ scientific performances and critical skills is Project Based Learning (PjBL) model. This model is recommendable for use with the 2013 Curriculum. Project Based Learning (PjBL) model is a teaching model that is based on the constructivist philosophy, which states that knowledge is the product of cognitive construction through an activity that constitute the students’ scientific skill and attitude so that they can construct their own knowledge meaningfully through real experiences. This teaching model is more focused on the concepts and involves the students in problem solving activities, giving the opportunity to the students to work autonomously, to construct their own learning, and, ideally, to enable the students to produce valuable and realistic products [7]. The PjBL is more effective in improving learning achievement in science teaching than the conventional teaching at school [8]. This is in conformity with the previous findings that show that PjBL can help students in doing their tasks, representing their ideas, and developing inter-conceptual relationships [9]. During the project work, the teacher should play the role as the guide and facilitator to give feedbacks to the objective(s) of the activity [10]. The Project Based Learning (PjBL) model with the aid of scientific assessment was selected in the science teaching because it has very great potential to develop the students’ scientific performances, to train their thinking process which is oriented toward their critical thinking skill, and to develop their scientific attitudes. Project Based Learning (PjBL) model can develop the students’ effort to develop complex and rich experiential memory representations, that show a strong interconnection between semantic and episodic experiences and actions. In addition, in the project - based learning, the students are motivated to become more active and creative in learning so that they can increase their scientific
performances, while the teacher has the role as facilitator and evaluates the process and product of the students which constitutes the outcome that can be presented from the project done [11]. The Project Based Learning (PjBL) model is one of the ways to maximize students’ activities in learning and can improve their activities and scientific performance and help them to develop their critical thinking skill and scientific attitude. The PjBL has the cooperative learning characteristics, improves the students’ learning motivation, creativity, activity, and fosters the elements of the life learning education [12]. PjBL has 5 steps i.e.: (1) establishing the project theme, (2) establishing the learning context, (3) planning the activity, (4) processing the activity, and (5) implementing the activity to implement the project. At the step of establishing the project theme, the students are given the opportunity to determine the theme of the project according to the existing problems. The learning context leads to the students working autonomously and to doing an inquiry based on their project theme. The activity planning will lead the students to looking for resources that are related to the project to be designed. The processing of the activity is related to the students’ activity in determining the steps in doing the project. The project implementation leads them to starting with the project based on the steps that have been determined and representing it. The implementation of the five steps of this learning model wholly in physics learning will optimize the students’ concepts understanding, thinking skill, process skill and scientific attitude. [11].

The putting of the 2013 Curriculum into effect has the consequence in the change in the system of evaluation. In the 2013 Curriculum, the evaluation of learning achievement consists of the evaluation of the competence in attitude, knowledge, and skill that are done in balance. One of the evaluations that gets an emphasis in the 2013 Curriculum is authentic assessment, that is, a comprehensive form of assessment made by the teacher sustainably (Regulation of the Ministry of Education and Culture No. 104 of 2014). However, the fact shows that teachers find it difficult to perform authentic assessment [13]. Authentic assessment is an integral part of science teaching. The science learning achievement of the group of students who were given an authentic assessment was higher than that of those who were given a conventional assessment. Hence, in this study, the effect of the implementation the PjBL model and authentic assessment in the class on the students’ learning achievement was investigated [14].

The rest of this paper is organized as follow: Section 2 describes the proposed research method. Section 3 presents the obtained results and following by discussion. Finally Section 4 concludes this work.

2. Proposed Method

This was a quasi-experiment. This study was called a quasi-experiment because not all of the variables that had an effect on the result could be controlled well and the process of sampling could not be done in a full randomization process. The study design used was the post-test only control group design. There were two variables in this study, i.e., independent and dependent variables. The independent variable was the teaching model and the dependent variables were scientific performance and critical thinking skill. The use of teaching models in treatment groups was differentiated into two, i.e., the use of Project Based Learning (PjBL) model in the experiment group and the use of conventional teaching in the control group. More specifically, the design can be seen in Table 1.

| Table 1. Posttest Only Control Group Research Design |
|---------------------------------|-----|-----|
| Group                          | Treatment (X) | Posttest (O) |
| Experiment (E)                 | X   | O₁,₂,₃ |
| Control (K)                    |     | O₁,₂,₃ |

The population of this study consisted of all the students in the ninth grade of the public junior high schools in Singaraja in the odd semester in the school year 2017/2018 with the total of 69 students.
SMP Negeri 1 Singaraja was chosen as the population of the study based on the considerations of reachability and viability. The reachability is mean the ease of access, so that speedy performance in the implementation of the study could be guaranteed. Viability means the chance of the realization of the teaching being experimented is great since the teachers of the school were experienced in implementing the 2013 Curriculum. The infrastructure and facilities were adequate to implement project based learning. Since based on the the characteristics of the population, all classes in the population were equivalent, the sampling was done by randomly selecting the sample from the existing classes. After drawing a lottery, two classes were obtained, i.e., the experiment class who learned using PjBL and authentic assessment that was composed of 30 students and the control class who learned using PjBL and conventional assessment that was also composed of 30 students.

The data were collected using a critical thinking skill test, a scientific attitude questionnaire, and self-efficacy questionnaire. The critical thinking test meets the indicators of interpretation, analysis, evaluation, inference and explanation. The test developed in this study was in a multiple choice format consisting of 30 items. The scientific attitude questionnaire meets the indicators of curiosity, respect for facts, critical reflection, diligence, open thinking, cooperation with others, willingness to accept uncertainties, and sensitivity toward the environment. There were 25 items in the scientific attitude questionnaire, the self-efficacy questionnaire was developed based on the aspects of difficulty level, level of strength, and generalization. The self-efficacy questionnaire consisted of 25 items. All of the instruments have met the requirement of validity and had a high reliability.

3. Results and Discussion

On the basis of data analysis, it was found out that the mean score for the students’ critical thinking of the students who learned using PjBL and authentic assessment (performance) was 71.00 (good qualification) was better than that of the students who learned using PjBL and conventional assessment, i.e., 64.83 (average qualification). Similarly, the mean score for the students’ scientific attitude of the students who learned using PjBL and authentic assessment was 80.76 (good qualification) was better than that of those who learned using PjBL and conventional assessment, i.e. 76.66 (good qualification). The mean score for self-efficacy of the students who learned using PjBL and authentic assessment was 87.50 (very good qualification) higher than that of those who learned using PjBL and conventional assessment with the mean score of 80.37 (good qualification). Then, before MANOVA statistical test was conducted, statistical prerequisite testing of data distribution normality, homogeneity of the experiment and control groups, and the inter-correlation between the dependent variable and the independent variables of critical thinking, scientific attitude and students’ self-efficacy was done. The results of data distribution normality were tested using Kolmogorov-Smirnov and was in the range between 0.125 and 0.150 (p > 0.05). So all of the data distributions were normal (See Table 2).

| Assessment         | Kolmogorov-Smirnova | Shapiro-Wilk |
|--------------------|---------------------|--------------|
|                    | Statistic | Df     | Sig. | Statistic | df     | Sig. |
| Critical thinking  | Conventional       | .149    | 30    | .088     | .959   | 30    | .289 |
|                    | Authentic          | .125    | 30    | .200*    | .980   | 30    | .834 |
| Scientific         | Conventional       | .150    | 30    | .085     | .919   | 30    | .025 |
| Attitude           | Authentic          | .128    | 30    | .200*    | .967   | 30    | .452 |
|                    | Conventional       | .134    | 30    | .182     | .942   | 30    | .102 |
| Self-efficacy      | Authentic          | .149    | 30    | .086     | .930   | 30    | .048 |
|                    | Conventional       | .134    | 30    | .182     | .942   | 30    | .102 |

a. Lilliefors Significance Correction

*. This is a lower bound of the true significance.
Based on the results of normality testing of data distribution both using Kolmogorov-Smirnov and Shapiro-Wilk tests it was found that all of the data have a normal distribution at the 5% level of significance. Therefore, the procedure could be continued with the homogeneity testing of the treatment and control groups. The results are shown in Table 3.

|                  | Levene Statistic | df1 | df2 | Sig.  |
|------------------|------------------|-----|-----|-------|
| **Critical Thinking** |                  |     |     |       |
| Based on Mean    | .001             | 1   | 58  | .978  |
| Based on Median  | .049             | 1   | 58  | .826  |
| Based on Median and with adjusted df | .049 | 1 | 57.969 | .826 |
| Based on trimmed mean | .002 | 1 | 58  | .968  |
| **Scientific Attitude** |                  |     |     |       |
| Based on Mean    | 1.972            | 1   | 58  | .166  |
| Based on Median  | 2.006            | 1   | 58  | .162  |
| Based on Median and with adjusted df | 2.006 | 1 | 56.196 | .162 |
| Based on trimmed mean | 2.015 | 1 | 58  | .161  |
| **Self-efficacy** |                  |     |     |       |
| Based on Mean    | 2.694            | 1   | 58  | .106  |
| Based on Median  | 2.642            | 1   | 58  | .109  |
| Based on Median and with adjusted df | 2.642 | 1 | 57.986 | .109 |
| Based on trimmed mean | 2.797 | 1 | 58  | .100  |

Based on the results of data analysis in Table 3, then it can be concluded that all groups (the treatment and the control groups) are homogeneous. Thus, the homogeneity requirement for the MANOVA has been met. The results of Intercorrelation test between critical thinking, scientific attitude and self-efficacy are shown in Table 4.

|                  | Critical Thinking | Scientific Attitude | Self-efficacy |
|------------------|-------------------|---------------------|---------------|
| **Critical Thinking** | Pearson Correlation | .045               | .250          |
| Sig. (2-tailed)   |                   | .731               | .054          |
| N                 | 60                | 60                 | 60            |
| **Scientific Attitude** | Pearson Correlation | .045               | .041          |
| Sig. (2-tailed)   |                   | .731               | .758          |
| N                 | 60                | 60                 | 60            |
| **Self-efficacy** | Pearson Correlation | .250               | 1             |
| Sig. (2-tailed)   | .054              | .758               |               |
| N                 | 60                | 60                 | 60            |

Based on the results of analysis as shown in Table 4, it is apparent that the inter-correlations between the dependent variables are all below 0.8. This means that there are not any strong correlations between the dependent variables of critical thinking, scientific attitude, and self-efficacy. It means that the variables of critical thinking, scientific attitude and self-efficacy are separate variables so that the analysis could be continued with MANOVA. Therefore, the requirement for using MANOVA has been met. The results of MANOVA, both simultaneous analysis and inter-subject analysis are consecutively presented in Tables 5 and 6.
Table 5. Results of Multivariate Test (Manova), Simultaneous Analysis Simultaneously

| Effect           | Value   | F     | Hypothesis df | Error df | Sig. |
|------------------|---------|-------|---------------|----------|------|
| Intercept        | .998    | 7481.155° | 3.000     | 56.000  | .001 |
| Wilks' Lambda    | .002    | 7481.155° | 3.000     | 56.000  | .001 |
| Hotelling's Trace| 400.776 | 7481.155° | 3.000     | 56.000  | .001 |
| Roy's Largest Root| 400.776 | 7481.155° | 3.000     | 56.000  | .001 |
| Assessment       | .365    | 10.739°  | 3.000     | 56.000  | .001 |
| Wilks' Lambda    | .635    | 10.739°  | 3.000     | 56.000  | .001 |
| Hotelling's Trace| .575    | 10.739°  | 3.000     | 56.000  | .001 |
| Roy's Largest Root| .575    | 10.739°  | 3.000     | 56.000  | .001 |

a. Design: Intercept + Assessment
b. Exact statistic

Table 6. Results of Multivariate Test t (MANOVA) Inter-subject

| Source            | Dependent Variable | Type III Sum of Squares | Df | Mean Square | F    | Sig. |
|-------------------|--------------------|-------------------------|----|-------------|------|------|
| Corrected Model   |                    |                         |    |             |      |      |
|                   | Critical Thinking  | 589.067°                | 1  | 589.067     | 10.221 | .002 |
|                   | Scientific Attitude| 252.150°                | 1  | 252.150     | 4.931  | .030 |
| Intercept         | Self-efficacy      | 763.267°                | 1  | 763.267     | 16.868 | .001 |
|                   | Critical Thinking  | 277168.067              | 1  | 277168.067  | 4808.971 | .001 |
|                   | Scientific Attitude| 371778.817              | 1  | 371778.817  | 7270.037 | .001 |
|                   | Self-efficacy      | 422688.267              | 1  | 422688.267  | 9341.296 | .001 |
| Assessment        | Critical Thinking  | 589.067°                | 1  | 589.067     | 10.221 | .002 |
|                   | Scientific Attitude| 252.150°                | 1  | 252.150     | 4.931  | .030 |
|                   | Self-efficacy      | 763.267°                | 1  | 763.267     | 16.87  | .001 |
| Error             | Critical Thinking  | 3342.867                | 58 | 57.636      | 1      |      |
|                   | Scientific Attitude| 2966.033                | 58 | 51.139      | 1      |      |
|                   | Self-efficacy      | 2624.467                | 58 | 45.249      | 1      |      |
| Total             | Critical Thinking  | 28110.000               | 60 | 803.500     | 10.74  | .005 |
|                   | Scientific Attitude| 374997.000              | 60 | 6249.938    | 1      |      |
|                   | Self-efficacy      | 426076.000              | 60 | 7101.267    | 1      |      |
|                   | Critical Thinking  | 3931.933                | 59 | 66.343      | 1      |      |
|                   | Scientific Attitude| 3218.183                | 59 | 54.901      | 1      |      |
|                   | Self-efficacy      | 3387.733                | 59 | 57.493      | 1      |      |

a. R Squared = .150 (Adjusted R Squared = .135)
b. R Squared = .078 (Adjusted R Squared = .062)
c. R Squared = .225 (Adjusted R Squared = .212)

On the basis of the results of analysis using MANOVA as shown in Tables 5 and 6 the following findings are established. Result of Hypothesis 1 testing. The hypothesis that states that simultaneously there is no difference between critical thinking, scientific attitude and self-efficacy between the students who learned using PjBL and authentic assessment and those who learned using PjBL and conventional assessment is rejected (F=10.74; p<0.05). In other words, simultaneously there is a difference between critical thinking, scientific attitude and self-efficacy between the students who learned using PjBL and authentic assessment and those who learned using PjBL and conventional assessment.

Result of Hypothesis 2 testing. The hypothesis that states that there is no difference in critical thinking between the students who learned using PjBL and authentic assessment and those who learned using PjBL and conventional assessment is rejected (F=10.22; p<0.05). In other words, there is a difference in critical thinking between the students who learned using PjBL and authentic assessment and those who learned using PjBL and conventional assessment.

Result of Hypothesis 3 testing. The hypothesis that states that there is no difference in scientific attitude between the students who learned using PjBL and authentic assessment and those who learned using PjBL and conventional assessment is rejected, (F = 4.93; p< 0.05). In other words, there is a
difference in scientific attitude between the students who learned using PjBL and authentic assessment and those who learned using PjBL and conventional assessment. Result of Hypothesis 4. Hypothesis 4 that states that there is no difference in self-efficacy between the students who learned using PjBL and authentic assessment and those who learned using PjBL and conventional assessment is rejected (F = 16.87; p < 0.05). In other words, there is a difference in self-efficacy between the students who learned using PjBL and authentic assessment and those who learned using PjBL and conventional assessment.

The results of analyses as shown in Tables 5 and 6 show that the students of the experiment group who learned using PjBL and authentic assessment could develop their critical thinking, scientific attitude, and self-efficacy in science teaching more effectively than those who learned using PjBL and conventional assessment. This is shown in the MNOVA result that shows that $F = 10.74$ with the level of significance lower than 5%. This is also supported by the mean scores for critical thinking, scientific attitude, and self-efficacy of the students that are higher in the group of students who learned using PjBL and authentic assessment than those in the group of students who learned using PjBL and conventional assessment. Viewed from the points of view of the mean scores for critical thinking, scientific attitude, and self-efficacy in science teaching, both for the experiment group and the control group it is apparent that only the critical thinking of the control group fell into the average qualification, while the critical thinking of the experiment group fell into the good qualification. The scientific attitude both of the students of the experiment group and the control group fell into the good qualification. The self-efficacy of the students was very good for the experiment group and good for the control group. These results show that PjBL gives a positive contribution to the improvement of the students’ scientific attitude and self-efficacy. Project Based Learning model is the learning model that attends to the students’ understanding in doing exploration, evaluation, interpretation and synthesizing information through a meaningful way. It can improve the students’ critical thinking in science teaching at junior high school [15]. It is able to develop the students’ creative thinking and problem solving ability in physics [16]. The PjBL and PBL are able to develop the students’ creative thinking and critical thinking abilities [17]. It is able to enhance the students’ learning achievement and self-efficacy in science teaching [18]. The students’ high critical thinking ability, problem solving ability and scientific attitude will have an effect on their self-efficacy.

The improvement of critical thinking, scientific attitude, and self-efficacy of the students was not only caused by the learning model, but it is also caused by authentic assessment in the teaching process. Authentic assessment is a form of assessment in which the students are asked to present their tasks in a real situation and to demonstrate the application of the skills and essential meaningful knowledge [19]. It is an assessment system that assesses the quality of the students’ task performances. This assessment technique is very suitable for assessing the students’ skill in demonstrating how they do [20]. It gives the opportunity to the students to demonstrate their understanding and to apply their knowledge, skills, and thinking habits in various contexts and makes learning more relevant to their daily life. In addition, authentic assessment can produce tangible products and the performance of the process of making the products [21].

In teaching science using PjBL, the performance tasks given can develop the students’ critical thinking, scientific attitude, and self-efficacy higher than in the one using conventional assessment. Authentic assessment is effective enough in increasing the students’ competence (knowledge, skill, and attitude) in physics [22]. In relation to authentic assessment, Hardianti, et al. in [23] found that the students gave positive responses to a web-based alternative assessment that was conducted by the lecturer with the percentage of 84.43%. Similarly, the use of authentic assessment in science practicum, is able to improve junior high school process skill [24]. Therefore, PjBL in combination with authentic assessment can increase students’ critical thinking, scientific attitude, and self-efficacy.

4. Conclusion and Future Work

Simultaneously, students’ critical thinking, scientific attitude, and self-efficacy can be developed more effectively by implementing PjBL with the aid of authentic assessment than by implementing PjBL with conventional assessment (only by using tests) In other words, authentic
assessment gives a positive contribution to the development of critical thinking, scientific attitude, and self-efficacy of the students. Based on the conclusion it can be suggested to the science teachers that they integrate PjBL and authentic assessment in science teaching since it is effective in developing critical thinking, scientific attitude, and self-efficacy of the students. The teachers minimally once in a semester can implement PjBL with the aid of authentic assessment for certain relevant topics. To the principal it is suggested that he provides complete science laboratory facilities to support the effectiveness of science teaching using the PjBL model. A further study needs to be done with a broader scope and more schools to see the result at a larger scale.

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References
[1] Gardner, H. (2007) *Five Minds for The Future* (Alih Bahasa Tome Beka), Gramedia Pustaka Utama..
[2] Tilaar, H.A.R. *Pengembangan Kreativitas dan Entrepreneurship dalam Pendidikan Nasional*. Jakarta: Penerbit Kompas, (2012).
[3] Suastrea, I W. (2013). *Pembelajaran Sains Terkini: Mendekatkan Siswa dengan Lingkungan Alamiah dan Sosial Budayanya*, Singaraja: Undiksha Press.
[4] Collette, A.T & Chiappetta, E.L. (1994). *Science Instruction in the Mide & Secondary School*. New York: Maxwell Macmillan International.
[5] Tim Pisa Indonesia. (2015). Hasil TIMSS 2015. [https://puspendik.kemdikbud.go.id/seminar/upload/Hasil%20Seminar%20Puspendik%202016/Rahmawati-Seminar%20Hasil%20TIMSS%202015.pdf](https://puspendik.kemdikbud.go.id/seminar/upload/Hasil%20Seminar%20Puspendik%202016/Rahmawati-Seminar%20Hasil%20TIMSS%202015.pdf)
[6] Sadia, I W. (2008). Model Pembelajaran yang Efektif untuk Meningkatkan Berpikir Kritis. *Jurnal Pendidikan dan Pembelajaran Undiksha*, 41(2), 219-237.
[7] Liu, W. C. (2007). *Project-Based Learning and Students’ Motivation*. Tersedia pada: [Http://Www.Google.Co.Id/ Project-Based-Learning Journalfiletype:Pdf](http://Www.Google.Co.Id/Project-Based-Learning Journalfiletype:Pdf) (diakses pada tanggal 20 Desember 2016).
[8] Cakiki, Y & Turkmen, N. (2013). An Investigation of Effect of Project-Based Learning Approach on Children’s Achievement and Attitude in Science. *The Online Journal of Science and Technology*, 2013, 3 2.
[9] Tal, T., Krajcik, J. S., & Blumenfeld, P. C. (2006). Urban Schools’ Teacher Enacting Project-Based Science. *Journal of Research in Science Teaching*, 43(7): 722-745.
[10] Kurzel, F., & Rath, M. (2007). Project Based Learning and Learning Environments. *Issues in Informing Science and Information Technology*, 4,503-510.
[11] Santyasa, I W. (2006). Pembelajaran Inovatif: Model Kolaboratif, Basis Proyek, dan Orientasi NOS *Makalah*. Disajikan dalam seminar di Sekolah Menengah Atas (SMA) Negeri 2 Semarapura.
[12] Sumarni, W. (2015). The Strength and weaknesses of the Implementation of Project-Based Learning: A Review. *International Journal of Science and Research*, 4, 3, 2015.
[13] Suastrea, I W & Ristiai., N.P. 2017. Problem Faced by Teachers in Designing and Implementing Authentic assessment in Science Teaching. *International Research Journal of Engineering, IT & Scientific Research*, 3(4), 24-32.
[14] Al-Sadaawi. (2008). An Investigation of Performance-Based Assessment in Science in Saudi Primary School. *Paper presented at 34th IAEA Annual Conference*, Cambridge UK, September 2008.
[15] Marlinda,N.L.P, I.W.Sadia, I.W Suastrea. (2012). Pengaruh Model Pembelajaran Berbasis Proyek Terhadap Kemampuan Berpikir Kreatif dan Kinerja Ilmiah Siswa. *Jurnal Pendidikan dan Pembelajaran IPA Indonesia*, Vol.2 (2).
[16] Mihardi, S., Mara, B. H., & Ridwan A. S. The Effect of Project Based Learning Model with KWL Worksheet on Student Creative Thinking Process in Physics Problem. *Journal of Education & Practice*, 5, 25. 2013.
[17] Anaizifa,R.D & Djukri. (2017). Project-Based Learning and Problem-Based Learning: Are They Effective to Improve Student’s Thinking Skill. *Jurnal Pendidikan Indonesia*, 6(2), 346-355.
[18] Bilgin, I., Yunus, K., & Yusuf, A. (2014). *Eurasia Journal of Mathematics, Science, & Technology Education*, 3-11.
[19] Stiggins, R.J. (1994). *Student-Centered Classroom Assessment*. New York: Prentice Hall.
[20] Hibbard, K.M. 1999. *Performance Assessment in The Science Classroom*. New York: Glencoe/McGraw-Hill.
[21] Marzano, Robert J, Debra J. Pickering, dan Jay McTighe. 1993. *Assessing Student Outcomes: Performance Assessment Using the Dimensions of Learning Models*. Alexandria: ASCD.
[22] Suastra, I W., Mardana, I. B., & Suwinda, N. P. (2007) Pengembangan Sistem Asesmen Kinerja dalam Pembelajaran Fisika di SMA. *Jurnal Pendidikan dan Pengajaran Undiksha*, 40, 1, 2007.
[23] Hardianti, R. D., M. Taufiq, and S. D. Pamela,sari. "The Development of Alternative Assessment Instrument in Web-Based Scientific Communication Skill in Science Education Seminar Course." *Jurnal Pendidikan IPA Indonesia* 6.1 (2017).
[24] Riantini, N.L.R, I.W Suastra, P.B. Adnyana. (2018). Development of Science Practicum Performance Assessment in Junior High School. *SHS Web of Conferences* 42. 00090.