# PEN III.A.1.b.1.h (iJET 15.6.2020)

*by* Saiful Prayogi

---

# The Effect of Problem-Based Learning with Character Emphasis toward Students' Higher-Order Thinking Skills and Characters

Suhirman, Yusuf
Universitas Islam Negeri Mataram, Mataram, Indonesia

Agus Muliadi, Saiful Prayogi (✉)
Universitas Pendidikan Mandalika, Mataram, Indonesia
saifulprayogi@ikipmataram.ac.id

**Abstract**—This study aimed to investigating the effect of problem-based learning with character emphasis toward the students' higher-order thinking skills (HOTS) and characters. This study an experimental research using the *single factor independent group design* which conducted on secondary school in Mataram - Indonesia. The treatment was given to three independent randomly selected groups, namely Problem-Based Learning with Character Emphasis (PBL-CE), Problem Based-Learning (PBL), and Regular Learning (RL). The data of the students' HOTS were collected through essay tests and the data of the students' characters were collected through self-assessment sheets, and analyzed using MANOVA. The results showed that the highest mean score for HOTS was found in the PBL-CE group, its was significantly different with RL group, and not significantly different with PBL group. Meanwhile, for the average score of student characters, the PBL-CE group scored higher and was significantly different from the other two groups (PBL and RL). The generalization of the study results has shown that there is an effect of problem-based learning with character emphasis on students' higher order thinking skills and character.

**Keywords**—Problem-based learning, higher-order thinking skills, character

## 1 Introduction

Education should be managed well in order to be able to produce thinker resources which are capable of developing knowledge-based socio-economic order in the 21st century [1] and facing industrial era 4.0 [2]. Students should be trained to use the power of argument, thinking skills, and moral or character in education because they will face rapid and challenging changes in science and technology [3, 4]. The important aspect of education that should be developed simultaneously is the thinking skills, in this case, high-order thinking skills [5, 6, 7, 8, 9] and characters [10, 11]. Education focuses not only on the development of academic performance, but also the overall capacity of the students [12].

HOTS is a skill which should exist during learning science [13]. HOTS is very important to develop for the students [14]. It can be used to predict the students successfull [15]. The HOTS developed in learning involves a number of thinking aspects. It is very complex [16], which covers a variety of thingking levels namely apllying, analyzing, evaluating, and creating [17]. According to Yen & Halili [18], it spesifically consists of critical and creative thinkings, problem solving, decision making and metacognition. This skill is required by the students when they will enter a practical world [19]. The students' HOTS in Indonesia are still low. A number of studies conducted on this issue reveal the same results. The students' scientific literacy skills are on the functional level in low category [20]. The results of test of scientific literacy skills on particular materials of natural science subject are medium by category, affected by such factors as curriculum and education systems, selection of methods and models of learning, facilities and infrastructures, learning resources, and teaching materials [21, 22]. Researches conducted in a number of favorite schools where the students gain high average scores also reveal that the students' competencies on HOTS are still very low [23]. The outcomes of 2018 Computer-Based National Examination at Junior High School level for science subject are down. The lower grade examination is supposedly caused by the test items which require high reasoning, namely HOTS [24].

Indonesia is a cultured and religious country which upholds the values of goodness in everyday life, later known as characters. The students should posses a positive character as citizens [25]. There should be an attemp to integrate character values into school subjects, but the teachers do not undertake it [26]. Seeing this condition, the learning process should develop HOTS and positive character for students. Learning should be designed to improve the academic performace as well as the students' character. Many students are unable to think critically because the teachers do not integrate critical thinking into their learning activities [27]. The learning models should be enriched and put together with character education. Developing and applying good characters in the learning will help schools develop morals and values [28] which are necessary for the students [29]. Such thing is vital for making sure that the learning should be emphasized on character building, not a mere achievement of academic results. In this study, the instructional interventions refer to the addtion of character contents to the syntax of the problem-based learning, later called as Problem-Based Learning with Character Emphasis (PBL-CE). This study aimed to investigating the effect of problem-based learning with character emphasis toward the students' higher-order thinking skills (HOTS) and characters.

## 2 Methodology

This study an experimental research using the single factor independent group design which conducted on secondary school in Mataram - Indonesia. The treatment was given to three independent randomly selected groups, namely Problem-Based Learning with Character Emphasis group (PBL-CE, N=71), Problem Based-Learning group (PBL, N=67), and Regular Learning group (RL, N=64). The pre-assessment

(pretest) of HOTS was carried out before the learning treatment. The teaching was carried out by teachers in ten times. After the treatment, the post-assessments (post-test) of the students' HOTS and character were carried out. The assessment of the students' HOTS included critical thinking, creative thinking, and problem solving. The assessment of the students' character covered religiousness, honesty, discipline, democraticness, curiosity, carness, and responsibility. Varabels of the students' HOTS were assessed throuh the test in the form of essay containing 17 items (reliability = 1.00). Variables of the students' character were assessed through self-assessment in the forms of self-assessment instrument (reliability = 0.81) and character observation sheet (reliability = 0.88). The data on the students' HOTS and character scores were analyzed descriptively with inferential statistics. Descriptive statistical analysis was applied to gain a descriptive data of the students' HOTS levels and character. Inferential statistics of the Manova was used to test the research hypothesis at the 0.05 level of significance.

## 3      Results and Discussion

The assessment of HOTS was carried out before and after the learning conducted in the three research groups. The effect of the treatment on the variables of HOTS was seen from the difference between posttest and pretest scores. The pretest and posttest score difference of the students' HOTS in the research groups is presented in Table 1. The average score of posttest and the difference of posttest and pretest was higher on the PBL-CE group than those on the PBL and RL groups. This fact indicates that the students' HOTS taught with the PBL-CE were better than those taught with the PBL and RL. PBL-CE was also able to encourage many students to get into very high and high category in comparison to the learning using the other two strategies as presented in Table 2.

**Table 1.** Students' HOTS results

| Descriptors | Groups | | | | | | | | |
| | PBL-CE | | | PBL | | | RL | | |
| | Pretest | Posttest | Diff. | Pretest | Posttest | Diff. | Pretest | Posttest | Diff. |
|---|---|---|---|---|---|---|---|---|---|
| N | 71 | 71 | | 67 | 67 | | 64 | 64 | |
| Ideal Max. Score | 51 | 51 | | 51 | 51 | | 51 | 51 | |
| Highest score | 31 | 43 | 12 | 26 | 41 | 15 | 22 | 36 | 14 |
| Lowest score | 3 | 19 | 16 | 5 | 16 | 11 | 2 | 11 | 9 |
| Median | 14 | 31 | 17 | 13 | 28 | 15 | 13 | 23 | 10 |
| Mode | 13 | 31 | | 7 | 31 | | 16 | 24 | |
| Average | 13.53 | 31.06 | 17.53 | 12.72 | 27.99 | 15.27 | 13.33 | 22.91 | 9.58 |
| Category | Low | High | | Low | Moderate | | Low | Moderate | |
| Deviation Stand. | 5.5 | 5.5 | | 4.6 | 5.3 | | 4.0 | 5.5 | |

**Table 2.** Students' HOTS category

| Score Interval | Category | PBL-CE | | PBL | | RL | |
|---|---|---|---|---|---|---|---|
| | | *Freq.* | *%* | *Freq.* | *%* | *Freq.* | *%* |
| 40,9 - 51 | Very High | 2 | 2.8 | 1 | 1.5 | 0 | 0.0 |
| 30,7 - 40.8 | High | 36 | 50.7 | 23 | 34.3 | 6 | 9.4 |
| 20,5 - 30.6 | Moderate | 31 | 43.7 | 38 | 56.7 | 36 | 56.3 |
| 10,3 - 20.4 | Low | 2 | 2.8 | 5 | 7.5 | 22 | 34.4 |
| 0 - 10.2 | Very Low | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| Total | | 71 | 100 | 67 | 100 | 64 | 100 |

The assessment of the students' character was conducted after the treatment was completed. The data on the results of descriptive statistical analysis of the students' character are presented in Table 3. The score of PBL-CE group was higher than the score of PBL and RL groups. This shows that the students' character taught with the PBL-CE is better than those taught with the PBL and the RL. The PBL-CE was also able to encourage the students to get into very good and good category in a higher portion in comparison to the learning with the other two strategies.

**Table 3.** Students' character results

| Descriptor | Groups | | |
|---|---|---|---|
| | *PBL-CE* | *PBL* | *RL* |
| Number of Subjects | 71 | 67 | 64 |
| Ideal maximum Score | 244 | 244 | 244 |
| Highest Score | 229 | 219 | 217 |
| Lowest Score | 170 | 153 | 146 |
| Median | 202 | 195 | 187.5 |
| Mode | 201 | 197 | 188 |
| Average | 200.99 | 195.13 | 186.88 |
| Category | Very Good | Good | Good |
| Deviation Standard | 11.0 | 13.0 | 13.7 |

The portion of the students based on the character category in the Research Group is presented in Table 4, where the students of PBL-CE group had a higher portion of the students who get ino very good and good category in comparison to the PBL group and the RL group. This indicates that the learning with PBL-CE has a better effect on the students' character.

**Table 4.** Students' character category

| Score Interval | Category | PBL-CE | | PBL | | RL | |
|---|---|---|---|---|---|---|---|
| | | *Freq.* | *%* | *Freq.* | *%* | *Freq.* | *%* |
| 195,3 - 244 | Very Good | 51 | 71.8 | 33 | 49.3 | 17 | 26.6 |
| 164,5 - 195.2 | Good | 20 | 28.2 | 34 | 50.7 | 46 | 71.9 |
| 97,7 - 146.4 | Fair | 0 | 0.0 | 0 | 0.0 | 1 | 1.6 |
| 48,9 - 97.6 | Poor | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| 0 - 48.8 | Very Poor | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| Total | | 71 | 100 | 67 | 100 | 64 | 100 |

Hypothesis testing of the MANOVA using SPSS 16.0 shows the probability value (p) was <0.05 on the multivariate test. It means that, H0 which states "there is no difference in the average score of the students' HOTS and character in the three treatment groups" is rejected. Thus, there is a significant effect of PBL-CE on the students' HOTS and character. Furthermore, a Post Hoc test was conducted to ensure the differences in the results of the three research groups, as presented in Table 5. The students' HOTS score taught with the PBL-CE were higher and it differed significantly in comparison to the RL, but it was not significantly different from the PBL, and the students' character score taught with PBL-CE was better and it was significantly different from the PBL and the RL.

**Table 5.** Results of post hoc test of the the students' HOTS and character

| Dependent Variable | (I) Grup | (J) Grup | Mean Dif. (I-J) | Std. Error | Sig. |
|---|---|---|---|---|---|
| HOTS | PBL-CE | 2 | 2.08 | .948 | .075 |
| | | 3 | 7.76* | .960 | .000 |
| | PBL | 1 | -2.08 | .948 | .075 |
| | | 3 | 5.68* | .973 | .000 |
| | RL | 1 | -7.76* | .960 | .000 |
| | | 2 | -5.68* | .973 | .000 |
| Character | PBL-CE | 2 | 5.85* | 2.139 | .019 |
| | | 3 | 14.11* | 2.165 | .000 |
| | PBL | 1 | -5.85* | 2.139 | .019 |
| | | 3 | 8.26* | 2.195 | .001 |
| | RL | 1 | -14.11* | 2.165 | .000 |
| | | 2 | -8.26* | 2.195 | .001 |

The conclusion of overall analysis above is that there is a significant effect of the PBL-CE on the students' HOTS and character. This positive effect was due to the characteristics of the PBL-CE in learning. During lesson process using the PBL-CE, characters were purposely designed through the teacher's action at each stage in the learning syntax. In several stages of the learning activities, there were always activities of the teacher to generate and strength the students' character and remind them to do something related to certain characters. In the learning using PBL-CE, the students were confronted with authentic problems on environment surrounding the students. The students would be good at critical thinking when they were confronted with the thinking tasks that did not always require the knowledge of content of the material, but the knowledge of everyday life [30]. The students were stimulated to be sensitive and cared about the problems which existed in their environment by learning the problems given. The environmental problems the students dealt with were in the form of pictures or photos and information in electronic media news. The pictures and information from the media are very appropriate for the students to develop their analytical thinking skills [31]. In the process of analyzing problems, the students familiarized themselves with caring personality, being critical to information, building polite communication among friends in a group, confirming the results of the analysis

honestly and courageously. These activities were carried out continuously in each time of the learning, so that the students get used to performing mental process with intellectual skills, learning various roles of adults through their involvement in real experiences or stimulation and becoming autonomous and independent learners.

Furthermore, the PBL-CE give the students the opportunity to discuss how they will find the answers to the questions or solve the environmental problems given, seek supporting information or knowledge from variety of sources such as the internet which enable them to be literate in technology. The activities of finding information and solving the problems affect the students' problem-solving skills [32]. The students get used to patience character in finding and selecting necessary information among the number of information obtained from various learning sources. After obtaining the necessary information, the students had the ability to think analytically and critically, to synthesize, and self-confidence to be successful in solving the problems that will motivate them to be confident in global competition.

## 4    Conclusion

The results showed that the highest mean score for HOTS was found in the PBL-CE group, it was significantly different with RL group, and not significantly different with PBL group. Meanwhile, for the average score of student characters, the PBL-CE group scored higher and was significantly different from the other two groups (PBL and RL). The generalization of the study results has shown that there is an effect of problem-based learning with character emphasis on students' higher order thinking skills and character.

## 5    Acknowledgement

## 6    References

[1] Boholano, H. B. (2017). Samart social networking: 21st century teaching and learning skills. Research in Pedagogy, 7(1), 21-29. https://doi.org/10.17810/2015.45

[2] Schwab, K. (2016). The Fourth Industrial Revolution. 91–93 route de la Capite CH-1223 Cologny/Geneva Switzerland: World Economic Forum

[3] Mapeala, R., & Siew, N. M. (2015). The development and validation of a test of science critical thinking for fifth graders. Springer Plus, 4(1), 1-13. https://doi.org/10.1186/s40064-015-1535-0

[4] Ritter, S. M., & Mostert, N. (2016). Enhancement of creative thinking skills using a cognitive-based creativity training. Journal of Cognitive Enhancement, 1(3), 243–253. https://doi.org/10.1007/s41465-016-0002-3

[5] Hugerat, M., & Kortam, N. (2014). Improving higher order thinking skills among freshmen by teaching sciencethrough inquiry. Eurasia Journal of Mathematics, Science & Technology Education, 10(5), 447–454. https://doi.org/10.12973/eurasia.2014.1107a

[6] Prayogi, S., Muhali, Yuliyanti, S., Asy'ari, M., Azmi, I. & Verawati, N. N. S. P. (2019). The effect of presenting anomalous data on improving student's critical thinking ability. International Journal of Emerging Technologies in Learning, 14(6), 133-137. https://doi.org/10.3991/ijet.v14i06.9717

[7] Prayogi, S., Yuanita, L. & Wasis. (2017). Critical-Inquiry-Based-Learning: Model of learning to promote critical thinking ability of pre-service teachers. Journal of Physics: Conference Series 947, 1-6. https://doi.org/10.1088/1742-6596/947/1/012013

[8] Prayogi, S., Yuanita, L. & Wasis. (2018). Critical-Inquiry-Based-Learning: A model of learning to promote critical thinking among prospective teachers of physic. Journal of Turkish Science Education, 15(1), 43-56. https://doi.org/10.1088/1742-6596/947/1/012013

[9] Wahyudi, Verawati, N.N.S.P., Ayub, S., & Prayogi. (2018). Development of inquiry-creative-process learning model to promote critical thinking ability of physics prospective teachers. Journal of Physics: Conf. Series 1108, 1-6. https://doi.org/10.1088/1742-6596/1108/1/012005

[10] Callina, K. S., Burkhard, B., Schaefer, H. S., Powers, J., Murray, E. D., Kobylski, G., Ryan, D. M., Kelly, D., Matthews, M. D., & Lerner, R. M. (2018). Character in context: Character structure among United States Military Academy cadets. Journal of Moral Education, 48(4), 1–26. https://doi.org/10.1080/03057240.2018.1528442

[11] Isdaryanti, B., Rachman, M., Sukestiyarno, Y. L., Florentinus, T. S., & Widodo, W. (2018). Teachers' performance in science learning management integrated with character education. Jurnal Pendidikan IPA Indonesia, 7(1), 9–15. https://doi.org/10.15294/jpii.v7i1.12887

[12] Mak, W. S. (2014). Evaluation of a moral and character education group for primary school students. Discovery-SS Student E-Journal, 3, 142–164.

[13] Sulaiman, T., Muniyan, V., Madhvan, D., Ehsan, S. D., Persekutuan, W., & Lumpur, K. (2017). Implementation of higher order thinking skills in teaching of science: A case study in Malaysia. International Research Journal of Education and Sciences, 1(1), 2550–2158

[14] Hugerat, M., & Kortam, N. (2014). Improving higher order thinking skills among freshmen by teaching sciencethrough inquiry. Eurasia Journal of Mathematics, Science & Technology Education, 10(5), 447–454. https://doi.org/10.12973/eurasia.2014.1107a

[15] Tanujaya, B., Mumu, J., & Margono, G. (2017). The relationship between higher order thinking skills and academic performance of student in mathematics instruction. International Education Studies, 10(11), 78–85. https://doi.org/10.5539/ies.v10n11p78

[16] Ramos, J. L. S., Dolipas, B. B., & Villamor, B. B. (2013). Higher order thinking skills and academic performance in physics of college students: A regression analysis. International Journal of Innovative Interdisciplinary Research, 4, 48-60.

[17] Tajudin, M. (2016). The link between higher order thinking skills, representation and concepts in enhancing TIMSS tasks. International Journal of Instruction, 9(2), 199-214. https://doi.org/10.12973/iji.2016.9214a

[18] Yen, T. S., & Halili, S. H. (2015). Effective teaching of higher-order thinking (HOT) in education. The Online Journal of Distance Education and E-Learning, 3(2), 41–47

[19] Suwono, H., Pratiwi, H. E., Susanto, H., & Susilo, H. (2017). Enhancement of students' biological literacy and critical thinking of biology through socio-biological case-based learning. Jurnal Pendidikan IPA Indonesia, 6(2), 213–222. https://doi.org/10.15294/jpii.v6i2.9622

[20] Mardhiyyah, L.A., Rusilowati, A., &Linuwih, S. (2016). Pengembangan instrumen ases-men literasi sains tema energi. Journal of Primary Education, 5(2), 147–154.

[21] Mamat, A, Saefudin, & Priyandoko, D. (2016). Kemampuan literasi sains siswa pada pembelajaran ekosistem. In Proceeding Biology Education Conference, 13(1).

[22] Rahayuni, G. (2016). Hubungan keterampilan berpikir kritis dan literasi sains pada pembelajaran ipa terpadu dengan model PBM dan STM. Jurnal Penelitian dan Pembelajaran IPA, 2(2), 131–146. https://doi.org/10.30870/jppi.v2i2.926

[23] Shidiq, A. S., Masykuri, & Mohammad, E. S. (2015). Analisis higher order thinking skills (HOTS) menggunakan instrumen two-tier multiple choice pada materi kelarutan untuk siswa kelas XI SMA N 1 Surakarta. In Prosiding Seminar Nasional Pendidikan Sains (SNPS) (pp. 159–166). https://doi.org/10.21009/03.snf2019.01.pe.55

[24] Suprayitno, T. (2018). Nilai UN SMP Jeblok. Retrieved from https://m.jawapos.com/pendidikan/28/05/2018/nilai-un-smp-jeblok

[25] Rosdiana, L., Subekti, H., & Setiawan, B. (2018). Strengthening students' characters and ecopreneurship through science, environment, technology, and society course. Jurnal Pendidikan IPA Indonesia, 7(2), 162-171. https://doi.org/10.15294/jpii.v7i2.14338

[26] Febrianti, E., Haryan, S., Supardi, K. I. (2015). Penyangga model problem based learning bermuatan karakter. Journal of Innovative Science Education, 4(1), 1–9.

[27] Choy, S.C. & Oo, P. S. (2012). Reflective thinking and teaching practices: A precursor for incorporating critical thinking into the classroom. International Journal of Instruction, 5(1), 167–182. https://doi.org/e-ISSN:1308-1470

[28] Dinkha, J. (2008). Effects of character education on the self-esteem ofintellectually able and less able elementary students in Kuwait. International Journal of Special Education, 5(4), 47–59

[29] Carr, D. (2007). Character in teaching. British Journal of Educational Studies, 55(4), 369–389. https://doi.org/10.1111/j.1467-8527.2007.00386.x

[30] Tiruneh, D. T., De Cock, M., & Elen, J. (2018). Designing learning environments for critical thinking: Examining effective instructional approaches. International Journal of Science and Mathematics Education, 16(6), 1065–1089. https://doi.org/10.1007/s10763-017-9829-z

[31] Sutarto, Indrawati, J. Prihatin, P. A. D. (2018). Geometrical optics process image-based worksheets for enhancing students' higher-order thinking skills. Jurnal Pendidikan IPA Indonesia, 7(4), 376–382. https://doi.org/10.15294/jpii.v7i4.14563

[32] Wahyuni, S., Indrawati, I., Sudarti, S., & Suana, W. (2017). Developing science process skills and problem-solving abilities based on outdoor learning in junior high school. Jurnal Pendidikan IPA Indonesia, 6(1), 165–169. https://doi.org/10.15294/jpii.v6i1.6849

## 7 Authors

**Suhirman** is a lecturer in Biology course, Department of Biology Education, Universitas Islam Negeri Mataram – Indonesia. His study concern in exploration the student's higher-order thinking skills.

**Yusuf** is a lecturer in Biology course, Department of Biology Education, Universitas Islam Negeri Mataram – Indonesia. His study concern in exploration the student's character.

**Agus Muliadi** is a lecturer in Biology course, Faculty of Mathematics and Science Education, Universitas Pendidikan Mandalika – Indonesia. His study concern in development interactive learning model based on scientific inquiry.

**Saiful Prayogi** is a lecturer in Physics Education, Faculty of Mathematics and Science Education, Universitas Pendidikan Mandalika – Indonesia. His study concern in development of critical thinking instruments assessment.

# PEN III.A.1.b.1.h (iJET 15.6.2020)

| 7 | Internet Source | 1 % |
|---|---|---|

| 8 | Widia, F Sarnita, A Irawan, Syafrudin, Armansyah, Nurdiana, Hunaepi, Sapnowandi, S Prayogi, M Asy'ari. "The effectiveness of guided inquiry learning tools in increasing students' activities and creative thinking skills", Journal of Physics: Conference Series, 2021 <br> Publication | 1 % |
|---|---|---|