



The Validity and Readability Test for the Development of PBL-Based UKBM Teaching Materials on the Physics of the Human Circulatory System is Oriented Towards Students' Critical Thinking

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Abstract: Indonesia's scientific literacy ability is low with a score of 389. This score can indicate the critical thinking skills of junior high school students. To improve critical thinking can be done by innovating learning tools. For this reason, this research was conducted using the R&D method to develop UKBM which can help students achieve learning mastery. UKBM is part of the learning tools. In this study, UKBM was prepared based on Problem Based Learning (PBL) on the physics of the human circulatory system. So that it can be used by students in learning to enrich their knowledge by oriented towards critical thinking skills. The model used in this research is ADDIE (Analysis, Design, Development, Implementation, and Evaluation). The research was conducted during the Covid-19 virus pandemic, so there has been no effectiveness test. The validity of UKBM was obtained through validation of Education Study Program lecturers at FMIPA UM and science teachers at SMPN 8 Malang. The readability test was carried out on 31 students of SMPN 8 Malang grades 9E and 9F who had received material on the physics of the human circulatory system. The percentage of UKBM product validity was 85.41% and the readability test percentage was 87.98%. Based on these results, the PBL-based UKBM on the Physics of the Human Circulatory System Oriented Critical Thinking Skills was declared valid and passed the readability test.

Keywords: Circulatory system; Critical thinking ability; PBL; UKBM

Introduction

The scientific literacy ability of Indonesian students is still low (Zahara & Atun, 2018). Indonesia ranks 74th out of 79 countries with an average scientific literacy score of 389 (Schleicher, 2018). PISA's scientific literacy scores can show the critical thinking skills of junior high school students (Pratiwi, 2019). Students' critical thinking ability is one of the high-level skills that are needed in the teaching and learning process (Bustami et al., 2019). According to Piaget's theory of development, the age of junior high school children is a transition from the concrete thinking stage to the formal thinking stage (Santrock, 2008). Armed with critical thinking skills, students can connect abstract learning materials with phenomena in everyday life (Yustiqvar, 2019). Several

indicators can be used to assess students' critical thinking activities, namely classifying, assuming, predicting, designing investigations, minimizing errors in investigations, observing, making graphs, interpreting data, analyzing, making conclusions, and evaluating (Carin, 1998). Critical thinking skills can train students to decide solutions to a problem, so they can optimize learning outcomes (Rusdi et al., 2016).

To improve students' literacy skills, it is necessary to make improvements in classroom learning (Hewi & Shaleh, 2020). Improvements can be made through the development of lesson plans (Depdiknas, 2008). Planning in learning includes lesson plans, syllabus, teaching materials, learning media, learning resources, assessment tools, and learning scenarios (Permendikbud, 2016). Based on the results of

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interviews with science teachers at SMPN 8 Malang, before carrying out learning the teacher developed learning tools in the form of lesson plans, LKPD, and assessment instruments. The device is developed according to the conditions of the school, students, and teachers' thoughts. Science learning covers three fields of science, namely physics, chemistry, and biology (Kemendikbud, 2018). In the process, students are led to gain understanding through natural phenomena around them. However, there is a material that is abstract so that it cannot be presented directly in front of students, such as blood circulation (Fadillah, 2018). To gain student's critical thinking, the blood circulation must be explained not only biologically but also physically. Because in science, the material consists of biology, physics, and chemistry. For this reason, students' ability to think critically is needed to understand the material of blood circulation (Prilyta et al., 2016).

Teaching materials can help students during the learning process (Dewi & Susilowibowo, 2016). Teaching materials are divided into visual, audiovisual, and interactive multimedia teaching materials (Depdiknas, 2008). Printed teaching materials include Community Based Health Efforts (known with UKBM), posters, brochures, leaflets, student worksheet, books, handouts, and modules (Al-Tabany, 2014). UKBM is one of the units in learning tools that can be used by students to achieve individual mastery of all Core Competency (known with KI) and Basic competencies (known with KD) (Kemendikbud, 2016). However, the use of UKBM in Indonesia is still relatively rare, because it was only tested in the 2017/2018 school year (Lisya, 2019). To facilitate students in developing their critical thinking skills, UKBM can be combined with several learning models such as Inquiry Learning, Discovery Learning, Problem Based Learning, and Problem Based Learning (Markhus et al., 2019).

Problem Based Learning helps students with various abilities and different perspectives on a problem to study together in small groups through analyzing problems, making hypotheses, solving problems, and drawing conclusions (Leasa et al., 2019). Through PBL-based UKBM students can develop critical thinking, creativity and innovation, collaboration, and communication skills (Charles Fadel, 2009). The results of previous research conducted by Ni Kadek Intan Dwipayanti in 2020 showed that UKBM based on the Science, Technology, Engineering and Math (STEM) Approach on respiratory system materials was very feasible to be used as a new alternative in teaching materials (Kadek et al., 2020). This is reinforced by the results of Gilang Pratiwi's research in 2020 which shows the development of e-UKBM with the kvisoft flipbook maker application in physics learning is feasible to improve students' problem-solving abilities. blood

circulation based on Problem Based Learning oriented to students' critical thinking skills.

Method

The research was carried out using the R&D method to produce a product in the form of PBL-based UKBM on the subject of Physics of the Human Circulatory System which is oriented towards students' critical thinking skills, research was carried out using the ADDIE model. The research was conducted to innovate existing products with several developments, namely PBL-based and using materials in KD 3.7 and 4.7 class VIII. For this reason, researchers adopted the ADDIE research model because it is simple, systematic, and provides opportunities for evaluation and revision in each phase. The ADDIE model consists of analysis, design, development, implementation and evaluation stages. At the analysis stage, a gap analysis is carried out between theory and reality in schools. At the design stage, UKBM plans and designs were prepared. In the development stage, UKBM development is carried out in accordance with the results of the previous stage. The implementation phase was not carried out properly because face-to-face learning was abolished during the Covid-19 pandemic. So it is feared that invalid data will be obtained if carried out. So that at the implementation stage a validation test and a readability test were carried out. The validation test was carried out by lecturers and science teachers at junior high schools, while the readability test was carried out for junior high school students. At the evaluation stage, evaluation and improvement of UKBM products is carried out.

Product validity is determined by the validator by filling out a questionnaire on the assessment instrument. Furthermore, a readability test was carried out on students. The data obtained are quantitative data and qualitative data. Quantitative data comes from the Likert scale and Guttman scale scoring. The Likert scale uses a score of 1 to 4 with a score of 1 strongly disagreeing, 2 disagreeing, 3 agreeing and 4 strongly agreeing. The Guttman scale uses a score of 0 with the statement "No/False" and a score of 1 with the description "Yes/True". While qualitative data comes from comments and suggestions given by the validator. The data analysis technique used is a descriptive analysis by calculating the average percentage score from the validation results and UKBM readability test with the Formula 1:

$$\text{Validity (\%)} = \frac{\sum x}{n} \times 100\% \quad (1)$$

Information :

Σx = the number of answers scores of each respondent on the assessed aspects

n = the number of answers the maximum score in the aspect of assessment

The percentage results obtained are then adjusted according to the criteria on Table 1.

Table 1. Criteria of percentage results obtained

Percentage	Description
0% - 20%	Not very good
21% - 40%	Not good
41% - 60%	Deficient
61% - 80%	Good
81% - 100%	Very good

(Riduwan, 2015)

Result and Discussion

Product development in the form of UKBM on the physics of human circulatory system material based on Problem Based Learning oriented students' critical thinking skills. The material in UKBM is adjusted to the 2013 curriculum at KD 3.7 and 4.7 for SMP class VIII. UKBM consists of UKBM identity (identity, subject name, semester, basic competence, IPKD, subject matter, time allocation, learning objectives, and learning materials), concept maps, learning process (instructions for use, introduction, and core activities), and closing in the form of self-reflection (Kemdikbud, 2017). Indicators of students' critical thinking activities are included in the PBL syntax. In the orientation syntax of students' critical thinking activities are Interpretation, Ask and answer questions. In the syntax of organizing students' critical thinking activities in the form of Analyzing, and Observe. In the syntax of individual and group investigations, critical thinking activities carried out by students are in the form of Basic Support. In the syntax of developing and presenting students' critical thinking activities in the form of Interference and Explanation. In the problem-solving evaluation syntax, students' critical thinking activities are in the form of Analyzing and Evaluation. Problem Based Learning syntax is integrated into UKBM. The lesson begins with an appreciation on the physics of human circulatory system material. Problem orientation activities are carried out by presenting problems in the form of real phenomena such as varicose veins. Real problems in UKBM are worked out in groups by discussing to solve problems. The results of the discussion are presented and commented on by other groups so that students' critical thinking is oriented to solve problems.

A validity test was conducted on UKBM to determine the validity of the products that have been developed. The product validators consist of UM Science Education Study Program lecturers and SMPN 8 Malang teachers who teach science subjects. Product validity indicators include materials, worksheets, and evaluation questions that can stimulate students to think critically. The validity test instrument uses a Likert scale

with a score of 1 to 4 (Likert, 1932). The instrument also uses the Guttman scale with a score of 0 and 1 to test the correctness of the material used (Guttman, 1944).

The results of the validation obtained a percentage score of 85.41% with a very good category (Riduwan, 2015). For this reason, UKBM products can be declared valid as scientific products. This is in accordance with Riduwan (2015), if the validity score is 81% then it can be declared valid for use. The truth of the concept of material on the physics of human circulatory system at UKBM obtained an average score of 1 with the correct category. The comments and suggestions obtained in the validation test need to correct some errors in writing and use questions that stimulate students more in critical thinking. These comments and suggestions are used as the basis for revision.

In addition, the UKBM readability test was conducted for students of SMPN 8 Malang who had received material on the physics of human circulatory system. The number of respondents for the readability test was 31 students, with a description of 23 students in grade 9E and 8 students in grade 9F. The indicators of the readability test include the display, the language used, the images presented, the material, the summary of the material, the command line, a worksheet that stimulates critical thinking and evaluation questions. The results of the readability test obtained an average score of 87.98% with a very good category (Riduwan, 2015).

UKBM products that have been developed have several advantages in facilitating students to study independently with their groups and helping students practice critical thinking in solving problems. In addition, the UKBM that has been developed helps teachers present student-centered learning. So if the product is actually applied in learning it can train students to think critically.

Conclusion

Based on the results of the research that has been carried out, it can be concluded that the PBL-based UKBM on the physics of human circulatory system material oriented to critical thinking skills is valid and passed the readability test with a validity percentage of 85.41% and a readability test percentage of 87.98%.

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References

Al-Tabany, T. I. B. (2014). *Mendesain Model Pembelajaran Inovatif, Progresif dan Konstektual*. Prenadamedia

- Group.
- Bustami, Y., Riyati, Y., & Julung, H. (2019). Think talk write with pictured cards on human digestive system: impact of critical thinking skills. *Biosfer: Jurnal Pendidikan Biologi*, 12(1), 13 - 23. <https://doi.org/10.21009/biosferjpb.v12n1.13-23>
- Carin, A. A. & S. R. B. (1998). *Teaching Science Trough Discovery*. Merril Publishing Company.
- Charles Fadel, B. T. (2009). *21st Century Skills: Learning for life in Our Times*. Jossey-Bass A Wiley Imprint.
- Depdiknas. (2008). *Panduan Pengembangan Bahan Ajar*. Departemen Pendidikan Nasional.
- Dewi, T. N. ., & Susilowibowo, J. (2016). Pengembangan LKS dalam Rangka Menunjang Pembelajaran Berbasis Scientific Approach pada Materi Laporan Keuangan Perusahaan Jasa. *Jurnal Pendidikan*, 4(3), 1-6. Retrieved from <https://ejournal.unesa.ac.id/index.php/jpak/articel/view/17055>
- Fadillah, N. (2018). Identifikasi Faktor Penyebab Miskonsepsi Siswa Tentang Materi Biologi di SMA Se-Kota Langsa. *Jurnal Pendidikan Biologi*, 7(2), 127-131. Retrieved from <http://jurnal.unimed.ac.id/2012/index.php/JPB>
- Guttman, L. (1944). A Basis for Scaling Qualitative Data. *American Sociological Review*, 9, 139-150. <https://doi.org/10.2307/2086306>
- Hewi, L., & Shaleh, M. (2020). Refleksi Hasil PISA (The Programme For International Student Assesment): Upaya Perbaikan Bertumpu Pada Pendidikan Anak Usia Dini. *Jurnal Golden Age, Universitas Hamzanwadi*, 04(1), 30-41. Retrieved from <http://www.e-journal.hamzanwadi.ac.id/index.php/jga/article/view/2018>
- Kadek, N., Dwipayanti, I., Citrawathi, D. M., Srie, K., & Julyasih, M. (2020). Pengembangan Unit Kegiatan Belajar Mandiri Berbasis Pendekatan STEM Pada Materi Sistem Respirasi Dengan Berbantuan Edmodo Untuk Kelas XI MIPA di SMA. *Jurnal Pendidikan Biologi Undiksha*, 7(2), 81-93. Retrieved from <https://ejournal.undiksha.ac.id/index.php/JJPB/article/view/29682>
- Kemdikbud. (2017). *Panduan Pengembangan Unit Kegiatan Belajar Mandiri (UKBM)*. Kementerian Pendidikan Indonesia.
- Kemendikbud. (2016). *Tujuan Pembelajaran Jenjang Sekolah Menengah*. Kementerian Pendidikan Indonesia.
- Kemendikbud. (2018). *Permendikbud Nomor 35 tahun 2018 Tentang Kurikulum Sekolah Menengah Pertama/ Madrasah Tsanawiyah*. Jakarta, 1-16.
- Leasa, M., Sanabuky, Y. L., Batlolona, J. R., & Enriquez, J. J. (2019). Jigsaw in teaching circulatory system: a learning activity on elementary science classroom. *Biosfer*, 12(2), 122-134. <https://doi.org/10.21009/biosferjpb.v12n2.122-134>
- Likert, R. (1932). Technique for the Measurement of Attitudes, A. *Encyclopedia of Research Design*, 22(140), 1-55. <https://doi.org/10.4135/9781412961288.n454>
- Lisya, U. (2019). *Keefektifan Pelaksanaan UKBM (Unit Kegiatan Belajar Mandiri) Pada Pembelajaran Matematika Di Kabupaten Sidoarjo*. Universitas Islam Negeri Sunan Ampel Surabaya.
- Markhus, M., Harjono, A., Syukur, A., Bahri, S., & Muntari. (2019). Analisis Rencana Pelaksanaan Pembelajaran (RPP) Terhadap Kesiapan Guru Sebagai "Role Model" Keterampilan Abad 21 Pada Pembelajaran IPA SMP. *Jurnal Penelitian Pendidikan IPA (JPPIPA)*, 5(1), 66-72. <https://doi.org/10.29303/jppipa.v5i1.171>
- Permendikbud. (2016). *Permendikbud Nomor 22 Tahun 2016 (Vol. 3, Issue 2)*.
- Pratiwi, I. (2019). Efek Program Pisa Terhadap Kurikulum Di Indonesia. *Jurnal Pendidikan Dan Kebudayaan*, 4(1), 51. <https://doi.org/10.24832/jpnk.v4i1.1157>
- Prilyta, R., Susanti, R., & Santoso, L. (2016). Pengaruh Penerapan Model Problem Based Learning Berbantuan Edmodo Pada Materi Sistem Peredaran Darah Terhadap Hasil Belajar Peserta Didik Kelas Xi Sma Negeri 8 Palembang. *Jurnal Pembelajaran Biologi: Kajian Biologi Dan Pembelajarannya*, 3(2), 169-182. <https://doi.org/10.36706/fpbio.v3i2.4690>
- Riduwan. (2015). *Dasar-Dasar Statistika*. Alfabeta.
- Rusdi, R., Evriyani, D., & Praharsih, D. K. (2016). Pengaruh Model Pembelajaran Peer Instruction Flip Dan Flipped Classroom Terhadap Hasil Belajar Kognitif Siswa Pada Materi Sistem Ekskresi. *Biosfer: Jurnal Pendidikan Biologi*, 9(1), 15-19. <https://doi.org/10.21009/biosferjpb.9-1.3>
- Santrock, J. W. (2008). *Psikologi Pendidikan*. Prenada Media Group.
- Schleicher, A. (2018). *PISA 2018 Insights and Interpretation*.
- Yustiqvar, M. (2019). Analisis Penguasaan Konsep Siswa Yang Belajar Kimia Menggunakan Multimedia Interaktif Berbasis Green Chemistry. *Journal Pijar MIPA*, 14(3), 135-140. <https://doi.org/10.29303/jpm.v14i3.1299>
- Zahara, H. S. & Atun, S. (2018). Effect of science-technology-society approach on senior high school students' scientific literacy and social skills. *Journal of Turkish Science Education*, 15(2), 30-38. <https://doi.org/https://doi.org/10.12973/tused.10228a>