Jurnal Pembelajaran Sains
VOLUME 8 NUMBER 1, JUNE 2024

http://journal2.um.ac.id/index.php/
ISSN: 2527-9157

Development of Problem-Based Learning Worksheets on the Human Circulatory System for Eighth-Grade Students

Laras Widoretno Nugrahaning Prasetyo, Indra Fardhani*, Erti Hamimi
Department of Science Education, State University of Malang, Indonesia.

Corresponding author's email: indra.fardhani.fmipa@um.ac.id

Abstract

Learning objectives can be achieved if students are active in the learning process. Student activeness can be assessed through their involvement in study groups, responsibility, and how they express their opinions. Therefore, problem-based teaching materials are needed to train students' thinking skills and to ensure they are active in learning activities. The aim of this study is to develop a Problem-Based Learning (PBL) Student Worksheet (LKPD) on the topic of the human circulatory system, test the validity of the product, and its practicality. The method used in this research is Research and Development (R&D) with the ADDIE model. Data collection involved 130 eighth-grade middle school students and 6 science teachers for practitioner validation and readability tests. The scope of this research is limited to the feasibility assessment of the Problem-Based Learning Student Worksheet by material experts, media experts, practitioners, and student readability tests. The teaching materials developed by the researchers include real-life problems to make them easily understood by students, supported by videos and articles to help understand the material. The validity test was conducted by lecturers from the Science Education Study Program at Universitas Negeri Malang and one science teacher. The material feasibility test achieved a percentage of 80.83%, categorized as valid, and the media feasibility test achieved a percentage of 90%, categorized as very valid. The practicality test was then conducted with students and science teachers. The student practicality test showed a percentage of 95.37% and 94.7% for teachers. Based on these results, it is concluded that the Problem-Based Learning Student Worksheet is feasible and practical for use in science learning.

***Keywords**: Teaching Materials, Student Worksheets, Problem-Based Learning, Critical Thinking*

Received: 2 May 2024 | Revised: 25 June 2024 | Accepted: 30 June 2024

INTRODUCTION

Natural Science is concerned with understanding natural phenomena. In addition to grasping skills related to evidence, ideas, or universal theories, Natural Science also includes the process of discovering new things (Norrizqa, 2021). The teaching techniques in Natural Science focus on directly imparting skills to develop competencies for exploring and understanding the natural world scientifically, implemented through scientific inquiry to stimulate scientific thinking, working, and attitudes (Susilo, 2012). Natural Science education is distinctive because it requires critical thinking skills to analyze problems. Providing opportunities for critical thinking is one of the key goals of Natural Science education (Rahayuni, 2016).

The ability to think critically in each individual does not necessarily improve with age. Critical thinking skills are related to the ability to identify, analyze, and solve problems innovatively and rationally, leading to valid opinions and conclusions. Each individual has different levels of critical thinking competence, depending on the guidance or experiences frequently undertaken to develop it (Fakhriyah, 2014). Critical thinking represents an intellectual potential that can be developed through learning methods, and every individual has the potential to develop critical thinking skills. Critical thinking is not solely for oneself but also for teaching others. This opinion is crucial because, for someone to succeed in any aspect, they are required to have the ability to think critically, as well as to reason inductively and deductively, such as knowing when to criticize and when to listen to others' ideas or suggestions (Zubaidah, 2010).

Teachers play a crucial role in developing students' potential to organize learning so that complex subjects, such as the human circulatory system, can be expressed clearly and understood by students (Zulhelmi et al., 2017). Additionally, teachers contribute to realizing practical learning because 21st-century skills shift the focus of learning from teacher-centered to student-centered. Based on this statement, the learning process factors for character formation and educators' competence in creating more practical and efficient learning methods are significant in the learning approach. The learning process factors include: 1) the educator's ability to choose strategies; 2) the educator's ability to select learning models; 3) the educator's ability to engage students in the learning process; and 4) the educator's ability to produce instructional materials (Riana Sari et al., 2022). Educators are essential components with a significant role in implementing learning strategies. The

success of a learning strategy's application is closely related to the educator's ability to apply methods, techniques, or learning models (Pane & Darwis Dasopang, 2017).

The selection of appropriate and accurate teaching media significantly impacts the success of learning, in addition to enhancing teacher competencies and abilities in designing instruction. Essentially, learning media serves as a bridge connecting facts or learning objects from educational sources transferred by the teacher to the students, aiming to achieve the targeted learning objectives (Susanto, 2021). One of the teaching tools used by educators to create active learning environments is the Student Worksheet. The Student Worksheet is a printed information sheet that includes material, summaries, and usage instructions for students to follow, based on the basic competencies to be achieved (Nilam et al., 2023). The use of Student Worksheets can be developed in various ways (Nurliawaty et al., 2017). One innovation that can be applied in the creation of Student Worksheets is integrating them with real-life problems that we often encounter.

Problem Based Learning (PBL) is a teaching approach that presents real-life cases as a framework for students to practice critical thinking and problem-solving skills, as well as to gain fundamental knowledge and ideas from the lesson material (Mayasari et al., 2022). The PBL model requires students to be active participants in the learning activities because this model does not solely focus on the educator, thus enhancing students' learning outcomes on the studied material (Syarifudin et al., 2021). PBL is a study structure based on the constructivist pattern, which centers on student-centered learning techniques (Mayasari et al., 2022). The application of PBL in learning is crucial because its goal is to solve everyday problems, thereby familiarizing students with real-life situations (Mulyadi & Ratnaningsih, 2022)

PBL involves three key aspects: the presence of a problem, student-focused learning, and learning in small groups. The implementation of the PBL model consists of five stages:1) Orientation of students to the problem. In the first session, the educator emphasizes the learning objectives, encourages student participation in problem-solving activities, and presents the problem; 2) Organizing students for learning. In this phase, the educator groups students into several teams and provides them with instructions; 3) Guiding individual or group investigations. During this phase, the educator guides students in collecting the necessary data, conducting research, and exploring to find explanations and solve the problem; 4) Developing and presenting the problem. In this phase, the educator assists students in designing and preparing reports and documentation; 5) Analyzing and evaluating the process and problem-solving results. In this final stage, the teacher supports students in reviewing the methods and findings of their observations (Hotimah, 2020).

Based on the needs analysis conducted through questionnaires with a teacher and several students at a public junior high school in Kediri Regency, it was found that during the Natural Science lessons, Student Worksheets developed using the Problem-Based Learning model were not utilized as learning resources. Instead, only the textbooks provided by the school were used, with no additional learning resources. This has led to a lack of development in students' critical thinking skills.

In response to this issue, there is a need for media or learning resources that can support active student engagement in the learning process. Therefore, this study aims to develop a teaching tool, namely the Problem-Based Learning Student Worksheet, to facilitate both educators and students in achieving the learning objectives effectively. This approach is intended to stimulate students to address real-life problems presented in the Student Worksheet, thereby enhancing their problem-solving skills and critical thinking.

RESEARCH METHODOLOGY

This research employs the Research & Development (R&D) methodology. The study aims to develop a Problem Based Learning Worksheets on the Human Circulatory, test the product's validity, and assess its practicality. The stages of this research method include:

1. Analysis Stage: Reviewing the need for teaching materials on the topic of the human circulatory system.
2. Design Stage: At this phase, the researcher designs Problem-Based Learning Worksheets for students.
3. Development Stage: In the next phase, the researcher develops Problem Based Learning Worksheets for students on the topic of the human circulatory system.
4. Implementation Stage: Testing the developed product through expert practitioner validation questionnaires, media expert validation questionnaires, material expert validation questionnaires, and student readability test questionnaires.
5. Evaluation Stage: Correcting the developed product based on the evaluation results to meet any unmet needs or improvements.

Here is an illustration of the ADDIE model stages:

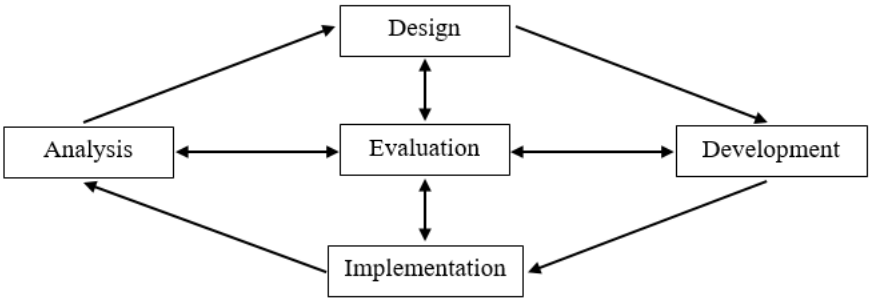


Figure 1. ADDIE Development Model
Source: Fudholi et al. (2020)

Target of this research is the science teacher and eighth grade students. Needs analysis was conducted in May 2023 involving science teachers and 16 students from class VIII-I. Meanwhile, the development research of Student Worksheet was conducted on February 21, 2024 involving eighth grade junior high school students (n = 130) and science teachers (n = 6). Below is the table of research methods used.

Table 1. Research Techniques
Source : Personal Document (2024)

Data Type	Test Name	Collection Technique	Subject	Analysis Method
Qualitative	Needs Analysis Test	Questionnaire	1 Grade VIII Science Teacher	Descriptive Analysis
Quantitative	Concept Validity Test	Questionnaire	Expert Lecturer	Guttman Scale Statistical Analysis
	Needs Analysis Test		16 Grade VIII Students	Likert Scale Analysis
	Material Validity Test		Expert Lecturer	
	Media Validity Test		Expert Lecturer	
	Student Readability Test		130 Students	
	Practicality Test		6 Science Teachers	

The data collection instruments used include expert validation questionnaires for content, media, and practitioner validation, as well as a readability test questionnaire for students. The validation questionnaire for the PBL Worksheets for Students developed utilizes a Likert scale. The Likert scale is employed to measure validators' perceptions or opinions regarding the developed product. Data collection techniques involve distributing questionnaires to junior high school educators and students. The type of data analyzed is descriptive quantitative. Suggestions or comments provided by validators constitute qualitative data, whereas responses from the questionnaire constitute quantitative data. Responses on the questionnaire use a Likert scale with five options: 1 for very good, 2 for good, 3 for fairly good, 4 for poor, and 5 for very poor. The data from the content expert validation questionnaire, media expert validation questionnaire, practitioner validation questionnaire, and student readability test questionnaire are then calculated as percentages. Subsequently, the percentage results of validity are matched with categories according to (Sarip et al., 2022) as presented in the table below.

Table 2. Validity Percentage Categories
Source : Sarip et al. (2022)

Nomor	Percentage (%)	Validity Level
1.	86 – 100	Very valid
2.	71 – 85	Valid
3.	56 – 70	Fairly valid
4.	41 – 55	Somewhat valid
5.	25 – 40	Not valid

The percentage results of the readability test obtained are then matched with categories according to (Rahima et al., 2022) as presented in the following table.

Table 3. Readability Test Categories
Source : Rahima et al. (2022)

Nomor	Percentage (%)	Validity Level
1.	80 ,1– 100	Very good
2.	60,1 – 80	Good
3.	40,1 – 60	Moderate
4.	20,1 – 40	Not good
5.	0,0 – 20	Very poor

RESEARCH RESULTS AND DISCUSSION

Needs Analysis

This research and development are based on the needs analysis of junior high school teachers and eighth-grade students. The needs analysis results for teachers were obtained using a needs analysis questionnaire. The following table presents the results of the needs analysis of teachers that have been conducted.

Table 4. Results of Teacher Needs Analysis
Source : Personal Document (2024)

Nomor	Question Response
1.	Most teachers use lecture and discussion methods.
2.	Learning media used include textbooks, PowerPoint presentations (PPT), Google Forms, videos, and visual media.
3.	The use of student worksheets learning media is still limited.
4.	A constraint in learning is the limited availability of LCD facilities in each classroom.

Based on the needs analysis of science teachers, it was found that the majority of teachers still use lecture or discussion methods. The lecture method involves delivering lesson material to students or practicing learned theories to achieve learning objectives (Adilah, 2017). In this method, the learning process is centered on the teacher, with students passively receiving information and tending to memorize material temporarily. According (Ramadhan, 2019), teachers who lack creativity can create a monotonous classroom environment, leading students to easily forget the taught material. The use of instructional media is also limited, with teachers typically relying on textbooks, which can make students appear bored during lessons.

In addition to the analysis of teachers' needs, an analysis of students' needs for the development of Student Worksheets was conducted using a student needs analysis questionnaire. The following table presents the results of the student needs analysis that has been conducted.

Table 5. Results of Student Needs Analysis
Source : Personal Document (2024)

Nomor	Question Response
1.	Students often find it difficult to learn about the circulatory system in science.
2.	Students are more interested in learning using printed media.
3.	Students have used Student Worksheets in science learning before.
4.	Students often find it difficult to develop or practice critical thinking skills in science learning.
5.	Students need the use of more engaging learning media to support science learning processes.

Based on the needs analysis conducted, it was found that students require engaging and innovative learning media to prevent difficulties or boredom during Natural Science lessons on the topic of the human circulatory system. Therefore, there is a need to develop teaching media that is appealing both in terms of appearance and content to support the learning process. This aligns with the view of (Purnasari & Sadewo, 2020) that teaching media can facilitate the delivery of material and help students understand what they are learning. Consequently, the researcher developed teaching media in the form of a Problem-Based Learning Student Worksheet on the topic of the Human Circulatory System.

Validation of Problem Based Learning-based Student Worksheets

After the instructional media was developed, the researcher conducted a validation phase with expert faculty members in media and subject matter from the Science Education Program at Universitas Negeri Malang. The test results are presented in the table below.

Table 6. Expert Material Validation Data
Source : Personal Document (2024)

Measurement Aspect	Average Score (%)
Content Feasibility	
Material aligns with Learning Objectives	60
Learning material is complete with a systematic order	60
The content of the Student Worksheets is easy for students to understand	80
The content of the Student Worksheets is aligned with the students' level of ability	80
Average per aspect	**70**
Language Feasibility	
Uses language that is easy for students to understand	100
Uses sentences that are easy to understand	100
Conforms to standard Indonesian language guidelines	80
Average per aspect	**93,33**
Presentation	
Uses example problems in learning activities that match the material	80
Uses practice problems that align with the material and learning targets	80
Average per aspect	**80**
Independent Learning	
The Student Worksheets are able to attract students' interest in learning	80
The Student Worksheets can help improve students' critical thinking	80
Average per aspect	**80**
Overall average percentage	**80,83**
Measurement level	**Valid**

Table 7. Expert Media Validation Data
Source : Personal Document (2024)

Measurement Aspect	Average Score (%)
Size of the Student Worksheets	
The size of the Student Worksheets conforms to ISO A4 standards	100
The margin and paper size on the Student Worksheets are appropriate	100
Average per aspect	100
Cover Design	
The cover illustration of the Student Worksheets reflects the content/teaching material	80
Cover design attracts students' interest in learning	80
Fonts used are readable in terms of type, size, and color	100
Title and cover information use proper Indonesian according to EYD	100
Average per aspect	90
Content Design of Student Worksheets	
The design of the Student Worksheets is attractive	80

The layout of the content in the Student Worksheets is clear	100
Fonts used in terms of type, size, and color are attractive and readable	80
Image alignment with text message (material)	60
Average per aspect	**80**
Overall average percentage	**90**
Measurement level	**Very valid**

The next stage after obtaining validation test results and feedback from lecturers is to collect data for readability tests among junior high school students and expert practitioner tests for junior high school educators. The results of the readability test for junior high school students and practitioner validation are presented in the following table:

Tabel 8. Results of the Readability Test of the Teaching Media Student Worksheets
Source : Personal Document (2024)

Measurement Aspect	Average Score (%)
Clarity	
I feel that the sentence structure in the Student Worksheets is appropriate	95,16
I feel that the sentences in the Student Worksheets are effective	95,99
I feel that the Student Worksheets use standard terminology	92,32
I feel that the language in the Student Worksheets is suitable for the students' developmental level	95,16
Average per aspect	94,66
Conformity with Language Rules	
I feel that the grammar in the Student Worksheets is accurate.	94,66
I feel that the spelling in the Student Worksheets is accurate.	95,99
I feel that the presentation of ideas in the Student Worksheets uses easy to understand and communicative sentences	97,66
Average per aspect	96,10
Presentation	
I feel that the use of terminology in the Student Worksheets is consistent	87,65
I feel that the instructions used are clear and easy to understand	100
I feel that the examples used can be found in everyday life	97,16
I feel that the images presented help in understanding the material	97,83
Average per aspect	95,66
Usefulness	
I feel that the Student Worksheets engaging and not boring for learning	94,49
I feel that the Student Worksheets make interpreting the material easier	95,66
Average per aspect	**95,08**
Overall average percentage	**95,37**
Measurement level	**Very good**

Tabel 9. Results of the Expert Evaluation of the Student Worksheets
Source : Personal Document (2024)

Measurement Aspect	Average Score (%)
Effective	

The Student Worksheets can be used to explain the material.	100
The exercises in the Student Worksheets support the evaluation process.	96,67
Average per aspect	98,33
Efficient	
The Student Worksheets are easy to use anywhere	83,33
The Student Worksheets are easy to use at any time	83,33
Average per aspect	83,33
Interactive	
The font used is easy to read	96,67
Creative	
The presentation of practice questions attracts students to work on them	100
The Student Worksheets can help students become active in the science learning process	96,67
Average per aspect	**98,33**
Overall average percentage	**94,17**
Measurement level	**Very valid**

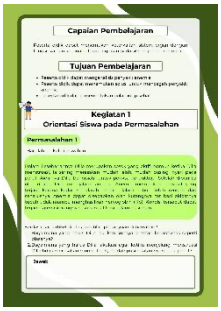
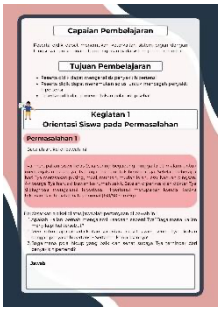
Discussion of Product Results

Figure 2. Cover Display of the Student Worksheet for Each Meeting
Source : Personal Design

The product developed in this research is a Problem-Based Learning Student Worksheet on the topic of the Human Circulatory System, consisting of several activities related to problems in daily life. The first page includes a cover page for each problem, supported by images to make the students more interested in studying the material. Then, there is an introduction section containing brief material about the problem in the Student Worksheet. This teaching tool includes four activities, namely: introducing students to the problem, organizing students to learn, guiding investigations, developing and presenting work results, and reviewing problem-solving techniques.

Table 10. Phenomena or Problems in the Problem-Based Learning Student Worksheet
Source : Personal Document (2024)

No.	Images of Problem-Based Learning Student Worksheets	Activities in the Problem-Based Learning Syntax in the Student Worksheet
1.		In Student Worksheet 1, a problem is presented about a young child who falls off their bike, causing a cut and bleeding on their leg. Based on this scenario, in Phase 1, students are asked to analyze the appropriate actions to take if they get such a wound and how to properly care for it to heal quickly. Next, in Phase 2, which is the learning organization phase, students are asked to sit with their group to work together in conducting an investigation. In Phase 3, there is a barcode scan containing a video explanation related to wound care problems, where students are asked to answer questions found in Phase 3. After that, in Phase 4, which is

		developing and presenting work results, students are asked to create a poster about wound care. In Phase 5, which is analyzing and evaluating the problem-solving process, students are asked to make a conclusion based on the learning they have done.
2.		In Student Worksheet 2, a problem is presented about a woman who feels easily tired, dizzy, and has abdominal pain during menstruation. This hinders her activities because she experiences anemia. Therefore, in Phase 1, students are asked to analyze and find solutions on what to do during menstruation to continue their usual activities. Next, in Phase 2, which is the learning organization phase, students are asked to sit with their group to work together in conducting an investigation. In Phase 3, there is a barcode scan containing a video explanation related to anemia problems, where students are asked to answer questions found in Phase 3. After that, in Phase 4, which is developing and presenting work results, students are asked to create a weekly menu to maintain a healthy lifestyle and avoid anemia. In Phase 5, which is analyzing and evaluating the problem-solving process, students are asked to make a conclusion based on the learning they have done.
3.		In Student Worksheet 3, an article is provided about teenagers who often stay up late and are lazy to exercise, resulting in nausea and dizziness. Due to this habit, they are diagnosed with hypertension. Therefore, in Phase 1, students are asked to analyze how to maintain a good lifestyle to avoid hypertension. Next, in Phase 2, which is the learning organization phase, students are asked to sit with their group to work together in conducting an investigation. In Phase 3, there is a barcode scan containing a video explanation related to hypertension problems, where students are asked to answer questions found in Phase 3. After that, in Phase 4, which is developing and presenting work results, students are asked to create a weekly schedule to maintain a healthy lifestyle and avoid hypertension. In Phase 5, which is analyzing and evaluating the problem-solving process, students are asked to make a conclusion based on the learning they have done.

After students consider the problem, they are asked to respond to the provided discussion. In the second activity, which is the organization of student learning, each group is asked to pay attention and discuss the previous problem. In the third activity, guiding the investigation, references such as videos or articles are provided to help respond to the questions in the Student Worksheet. The fourth activity, developing and presenting the creation, involves providing each group with instructions to create their work, such as making a poster, creating a food menu, or designing a weekly schedule. In the final activity, reviewing the problem-solving process, students are instructed to make conclusions based on the learning they have completed.

The benefits of the developed teaching tools include adding to the resources used in the Natural Science learning process, so students are not limited to textbooks or student worksheets in their Natural Science studies. Additionally, the benefits of the Student Worksheet for students include being active in the learning method, supporting the development of concepts they are learning, and cultivating thinking and process skills. The advantage of the Student Worksheet developed by the researchers is that it is based on problem-based learning, allowing students to develop critical thinking. The problems presented in the Student Worksheet are drawn from phenomena in the surrounding environment, making it easier for students to interpret the content of the Student Worksheet material. Moreover, the Student Worksheet is supported by images and videos to increase students' motivation to study the circulatory system material.

According to Table 3, the data from the material expert validation results show a validation score of 80.83%. This score falls into the valid category. The material experts provided comments and suggestions,

indicating that the material in the Student Worksheet was not entirely aligned with the learning objectives and targets and suggesting that the Student Worksheet should include narratives or materials related to the problem. The material expert validation questionnaire included several perspectives, such as content appropriateness, language appropriateness, presentation, and independent learning. The material in the developed Student Worksheet is considered complete, with a systematic sequence and structure, as the material or content in teaching tools is an important aspect to consider to ensure students can digest the material being studied. This aligns with the statement by (Ramda, 2017) that aspects of material, presentation, language, and graphics support the feasibility of teaching media used to ensure efficient learning. Furthermore, the structure within the teaching media should be considered to help students improve their cognitive abilities and knowledge during the learning process.

The validation results of the media experts in Table 4 show that the developed learning tools are declared highly valid or highly feasible. This is indicated by an average percentage result of 90%. Through the validation, feedback from the lecturers suggested that the layout images on the Student Worksheets should be changed or added according to the material in the Student Worksheets. The cover illustration of the Student Worksheets should match the content or material in the worksheets, which is about the human circulatory system. The cover includes the title of the teaching media, images related to the material in the Student Worksheets, the university logo, and the team of authors. This aligns with the opinion of (Nurasih et al., 2020), which states that the cover or front page aims to express the concept of the teaching media or the content intended to be conveyed to the readers. Additionally, the content in the Student Worksheets has an attractive and clear design and layout, and the use of font type, size, and color is easy to read, making it easier to understand. This aims to attract students' interest and foster curiosity about the Student Worksheets.

The readability test results in Table 5 show an average percentage of student readability testing of the Student Worksheet teaching media is very good, with an average percentage result of 95.37%. This indicates that the teaching tools created are very good at reviewing the human circulatory system material. The student readability test questionnaire included several assessment aspects: conciseness, adherence to language rules, presentation aspects, and usefulness aspects. Students also provided feedback on the Student Worksheets, such as adding images to make them more attractive and making the colors in the Student Worksheets more vibrant. However, most students stated that the product created was already good and suitable for use in the learning process.

Based on the readability test questionnaire, the conciseness perspective received a percentage value of 94.66% with very good criteria. The adherence to language rules perspective showed a percentage value of 96.10%. These results indicate that the sentences or terms used in the teaching media Student Worksheets and the language used are consistent with students' developmental levels, and the grammar and spelling are correct. Additionally, the ideas presented in the Student Worksheets are communicated using easily understood and communicative sentences. This is supported by (Paramita et al., 2019), who stated that the terms used should follow proper pronunciation, use appropriate, correct, and clear language, making it easy to read and understand. Furthermore, clear, concise, simple, and unambiguous discourse helps students learn more easily (Rahima et al., 2022).

In the presentation perspective, a percentage value of 95.66% with very good criteria was obtained. This result indicates that the terms used are consistent, the instructions provided are clear and easy to understand, the examples used are relatable to everyday life, and the images help understand the material. This is supported by the statement of (Isabela et al., 2021) that learning models that utilize real-life cases as a framework for students to learn thinking skills and problem-solving techniques help them acquire knowledge based on the material they study.

In the usefulness aspect, a percentage value of 95.37% with very good criteria was obtained. This indicates that the teaching media is engaging and not boring, making it easier for students to grasp the material being studied. This is supported by the statement of (Purba & Harahap, 2022) that teaching media is an important factor in education, making teaching materials necessary to capture students' attention and prevent boredom.

The practitioner or middle school teacher validation test results in Table 6 showed a percentage value of 94.17% with very valid or very feasible criteria. The practitioner expert validation questionnaire included several assessment aspects: effectiveness, efficiency, interactivity, and creativity. In the effectiveness and efficiency aspects, the practitioner expert test showed a percentage value of 98.33% with very valid criteria and 83.33% with valid criteria. These results indicate that the Student Worksheets can be used to explain material, assist in the evaluation process, and are simple to use anytime and anywhere. This aligns with (Umbaryati, 2016) statement that Student Worksheets are tools to support teaching and learning activities, fostering interaction between students and teachers and enhancing students' learning activities and

achievements. The approach used in the learning process also influences thinking patterns and logic processing to ensure optimal learning and teaching activities can be carried out effectively and efficiently.

In the interactivity aspect, a percentage of 96.67% with very valid criteria was obtained. This indicates that the researcher used easily readable fonts. This is reflected in the content of the Student Worksheets, where the font variations, sizes, colors, and spacing between lines or paragraphs are appropriate, making it clear for readers to understand the material. This is consistent with (Suryanti et al., 2021), who explained that developing interactive teaching tools facilitates the learning and teaching process for students and teachers. In the creativity aspect, a percentage of 98.33% with very valid criteria was obtained. This shows that the presentation of exercises in the Student Worksheets attracts students to engage and helps train them to be active in the Natural Science learning process. This is evident in the exercises in the Student Worksheets, which use real-life problems, making it easier for students to identify and analyze these problems. This aligns with (Setianingrum, 2017) statement that teaching requires creative learning techniques and the use of creative teaching tools to ensure that the knowledge provided is well-received by students. Therefore, the use of varied teaching tools in education is necessary to convey the material effectively.

Overall, the development of Problem-Based Learning Student Worksheets on the topic of the human circulatory system is feasible for use in the learning process. However, there are challenges in this development, such as the inclusion of some video links explaining problems or material on the YouTube application, which can be problematic for students without mobile phones or internet access.

CONCLUSION AND RECOMMENDATIONS

A. Conclusion

Based on the research conducted, it can be concluded that the Problem Based Learning based Student Worksheet for the human circulatory system was developed through several phases. These phases included developing the teaching media, validating it by subject matter and media experts, distributing readability questionnaires to junior high school students, and validation questionnaires to junior high school teachers. The validation tests indicate that the PBL Student Worksheet is suitable for use in Natural Science education. This is also supported by the practical usability tests conducted by junior high school teachers, confirming that the teaching media is appropriate for fostering active learning in Natural Science. Additionally, student responses to the PBL Student Worksheet have been positive. Students expressed interest in using the PBL Student Worksheet in Natural Science education and did not find it boring.

B. Recommendations

Although this research was conducted using appropriate procedures, there are still limitations. The study was only carried out up to the readability test for students and the validation test for junior high school teachers, aimed at determining the feasibility of the Student Worksheets for use in teaching. Based on the previous explanations, the researcher suggests that educators and students maximize the use of the Student Worksheets in the learning process. Future researchers are encouraged to implement these Problem-Based Learning Student Worksheets in the teaching of Science.

ACKNOWLEDGEMENTS

The researcher would like to express gratitude to the supervising lecturer who guided the researcher throughout this study, the subject matter experts, and the science teachers who dedicated their time and provided assistance during the research process. Additionally, the researcher extends thanks to the 8th-grade students of SMP Negeri 1 Gampengrejo who contributed to the data collection for this study.

REFERENCES

A. Suryanti, I.N.A.S. Putra, & F. Nurrahman. (2021). Pengembangan Media Pembelajaran Energi Alternatif Berbasis Multimedia Interaktif. *Jurnal Teknologi Pembelajaran Indonesia*, *11*(2), 147–156. https://doi.org/10.23887/jurnal_tp.v11i2.651

Adilah, N. (2017). Perbedaan Hasil Belajar IPA melalui Penerapan Metode Mind Map dengan Metode Ceramah. *Indonesian Journal of Primary Education*, *1*(1), 98. https://doi.org/10.17509/ijpe.v1i1.7521

Fakhriyah, F. (2014). Penerapan problem based learning dalam upaya mengembangkan kemampuan berpikir kritis mahasiswa. *Jurnal Pendidikan IPA Indonesia*, *3*(1), 95–101. https://doi.org/10.15294/jpii.v3i1.2906

Fudholi, D. H., Kurniawan, R., Jalaputra, D. P. E., & Muhimmah, I. (2020). Development of Virtual Reality Applications with the ADDIE Model for Prospective Educators of Children with Autism. *Jurnal RESTI*

(Rekayasa Sistem Dan Teknologi Informasi), *4*(4), 672–681. https://doi.org/10.29207/resti.v4i4.2092

Hotimah, H. (2020). Penerapan Metode Pembelajaran Problem Based Learning Dalam Meningkatkan Kemampuan Bercerita Pada Siswa Sekolah Dasar. *Jurnal Edukasi*, *7*(3), 5. https://doi.org/10.19184/jukasi.v7i3.21599

Isabela, Miftahus, S., & Puspitasari, Y. (2021). Penerapan Model PBL (Problem Based Learning) untuk Meningkatkan Kemampuan Percaya Diri Siswa. *Jurnal Pendidikan Tambusai*, *5*(2), 2729–2739. https://doi.org/10.26858/tpj.v2i3.26295

Mayasari, A., Arifudin, O., & Juliawati, E. (2022). Implementasi Model Problem Based Learning (Pbl) Dalam Meningkatkan Keaktifan Pembelajaran. *Jurnal Tahsinia*, *3*(2), 167–175. https://doi.org/10.57171/jt.v3i2.335

Mulyadi, K., & Ratnaningsih, N. (2022). Analisis Pencapaian Dan Kendala Penerapan Problem Based Learning Pada Pembelajaran Tatap Muka Terbatas (Ptmt). *J-KIP (Jurnal Keguruan Dan Ilmu Pendidikan)*, *3*(1), 37. https://doi.org/10.25157/j-kip.v3i1.7023

Nilam, N., Fitri, R., & Selaras, G. H. (2023). Meta-analisis Pengembangan LKPD Berbasis Problem Based Learning. *EduNaturalia: Jurnal Biologi Dan Kependidikan Biologi*, *4*(2), 69. https://doi.org/10.26418/edunaturalia.v4i2.65774

Norrizqa, H. (2021). Berpikir Kritis dalam Pembelajaran IPA. *Prosiding Seminar Nasional Pendidikan IPA*, 147–154.

Nurasih, Y. P., Wahyuni, I., & Leksono, S. M. (2020). Pengembangan Majalah Invertebrata sebagai Sumber Belajar Siswa SMA pada Subkonsep Invertebrata. *Gagasan Pendidikan Indonesia*, *1*(2), 87. https://doi.org/10.30870/gpi.v1i2.9886

Nurliawaty, L., Mujasam, M., Yusuf, I., & Widyaningsih, S. W. (2017). Lembar Kerja Peserta Didik (Lkpd) Berbasis Problem Solving Polya. *JPI (Jurnal Pendidikan Indonesia)*, *6*(1). https://doi.org/10.23887/jpi-undiksha.v6i1.9183

Pane, A., & Darwis Dasopang, M. (2017). Belajar Dan Pembelajaran. *FITRAH:Jurnal Kajian Ilmu-Ilmu Keislaman*, *3*(2), 333. https://doi.org/10.24952/fitrah.v3i2.945

Paramita, R., Panjaitan, R. G. P., & Ariyati, E. (2019). Pengembangan Booklet Hasil Inventarisasi Tumbuhan Obat Sebagai Media Pembelajaran Pada Materi Manfaat Keanekaragaman Hayati. *Jurnal IPA & Pembelajaran IPA*, *2*(2), 83–88. https://doi.org/10.24815/jipi.v2i2.12389

Purba, Y. A., & Harahap, A. (2022). Pemanfaatan Aplikasi Canva Sebagai Media Pembelajaran Matematika Di SMPN 1 NA IX-X Aek Kota Batu. *Jurnal Cendekia : Jurnal Pendidikan Matematika*, *6*(2), 1325–1334. https://doi.org/10.31004/cendekia.v6i2.1335

Purnasari, P. D., & Sadewo, Y. D. (2020). Perbaikan Kualitas Pembelajaran Melalui Pelatihan Pemilihan Model Pembelajaran Dan Pemanfaatan Media Ajar Di Sekolah Dasar Wilayah Perbatasan. *Publikasi Pendidikan*, *10*(2), 125. https://doi.org/10.26858/publikan.v10i2.13846

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. https://doi.org/10.30870/jppi.v2i2.926

Rahima, R., Kaspul, K., & Putra, A. P. (2022). Validitas Dan Keterbacaan Peserta Didik Kelaas X Sma Terhadap Pengembangan Modul Elektronik Berbasis Flip Html5 Konsep Protista. *Jurnal Pendidikan UNIGA*, *16*(1), 570. https://doi.org/10.52434/jp.v16i1.1828

Ramadhan, A. (2019). Metode Ceramah Untuk Pembelajaran. *Jurnal Pendidikan*.

Ramda, A. H. (2017). Analisis kesesuaian materi buku teks Kemendikbud matematika kelas VII dengan Kurikulum 2013. *PYTHAGORAS: Jurnal Pendidikan Matematika*, *12*(1), 12. https://doi.org/10.21831/pg.v12i1.14057

Riana Sari, W., Nuzzullah Putri, A., & Murhartati, E. (2022). Pengembangane-Worksheet Berbasis Problem Based Learning Terintegrasi Stem Pada Materi Sistem Peredaran Darah Kelas Xi Sma. *Kajian Biologi Dan Pembelajarannya*, *9*(1), 2613–9936.

Sarip, M., Amintarti, S., & Utami, N. H. (2022). Validitas dan Keterbacaan Media Ajar E-Booklet untuk Siswa SMA / MA Materi Keanekaragaman Hayati. *JUPEIS: Jurnal Pendidikan Dan Ilmu Sosial*, *1*(1), 43–59.

Setianingrum, M. (2017). Penggunaan Variasi Media Ajar Terhadap 3 Gaya Belajar Siswa Dalam Pembelajaran Bahasa Jepang. *JAPANEDU: Jurnal Pendidikan Dan Pengajaran Bahasa Jepang*, *2*(1), 1. https://doi.org/10.17509/japanedu.v2i1.6561

Susanto, T. A. (2021). Pengembangan E-Media Nearpod melalui Model Discovery untuk Meningkatkan Kemampuan Berpikir Kritis Siswa di Sekolah Dasar. *Jurnal Basicedu*, *5*(5), 3498–3512. https://jbasic.org/index.php/basicedu/article/view/1399

Susilo. (2012). Pengembangan Model Pembelajaran Ipa Berbasis Masalah Untuk Meningkatkan Motivasi

Belajar Dan Berpikir Kritis Siswa Smp. *Journal of Primary Education*, *1*(1). https://doi.org/10.15294/jpe.v1i1.58

Syarifudin, A., Dhewy, R. C., & Agustina, E. N. S. (2021). Pengaruh Model Brain Based Learning Terhadap Hasil Belajar Siswa. *JEDMA Jurnal Edukasi Matematika*, *1*(2), 1–7. https://doi.org/10.51836/jedma.v1i2.155

Umbaryati, U. (2016). Pentingnya LKPD pada pendekatan scientific pembelajaran matematika. *PRISMA, Prosiding Seminar Nasional Matematika*, 217–225. https://journal.unnes.ac.id/sju/index.php/prisma/article/view/21473%0Ahttps://journal.unnes.ac.id/sju/index.php/prisma/article/download/21473/10157

Zubaidah, S. (2010). Berfikir Kritis : Kemampuan Berpikir Tingkat Tinggi Yang dapat Dikembangkan Melalui Pembelajaran Sains. *Seminar Nasional Sains 2010 Dengan Tema "Optimalisasi Sains Untuk Memberdayakan Manusia," 16*(January 2010), 1–14. https://www.researchgate.net/profile/Siti-Zubaidah-7/publication/318040409_Berpikir_Kritis_Kemampuan_Berpikir_Tingkat_Tinggi_yang_Dapat_Dikembangkan_melalui_Pembelajaran_Sains/links/59564c650f7e9b591cda994b/Berpikir-Kritis-Kemampuan-Berpikir-Tingkat-Tingg

Zulhelmi, Adlim, & Mahidin. (2017). Pengaruh Media Pembelajaran Interaktif Terhadap Peningkatkan Keterampilan Berpikir Kritis Siswa. *Jurnal Pendidikan Sains Indonesia*, *05*(01), 72–80. http://jurnal.unsyiah.ac.id/jpsi