

PROBLEM-BASED LEARNING (PBL) BASED E-WORKSHEETS ON DIGESTIVE SYSTEM MATERIAL TO IMPROVE JUNIOR HIGH SCHOOL STUDENTS' CRITICAL THINKING SKILLS

Dini Fitria^{1*}, Vira Angrella, Endah Suciatty, Malika Nurul Annisa

Program Studi Pendidikan Biologi, Fakultas Keguruan dan Ilmu Pendidikan, Universitas Samudra, Indonesia

*Corresponding Author: dinifitria91@unsam.ac.id

ARTICLE INFO:

ABSTRACT

Article History:

Received: May, 20th 2025

Revised : August, 27th 2025

Accepted: September, 30th 2025

Keywords:

Problem-Based Learning, E-Worksheets, critical thinking, digestive system

This research aims to develop and implement an electronic student worksheet based on Problem-Based Learning (PBL) for digestive system material to enhance the critical thinking skills of junior high school students. The PBL model, which emphasizes problem-solving and student-centered learning, is integrated into interactive digital worksheets to facilitate learning anytime and anywhere. This study employed the ADDIE instructional design model, but was limited to the development phase. The validation process involved media and content experts to assess the feasibility of the developed PBL-based E-Worksheet. Validation results indicated that the media aspect received an average score of 77.7%, categorized as feasible, though revisions were needed in supporting images that were deemed less appropriate. Meanwhile, the content aspect obtained a score of 69.4%, also classified as feasible, with suggestions for improvement in learning indicators, images, and supporting videos. Based on these validation outcomes, the PBL-based E-Worksheet was deemed suitable for trial implementation. However, this study was confined to the development stage. Therefore, further research is recommended to evaluate the effectiveness and practicality of E-Worksheet in enhancing students' critical thinking skills.

Copyright © 2019 Universitas Negeri Medan. Artikel Open Access dibawah lisensi CC-BY-4.0 (<https://creativecommons.org/licenses/by/4.0>)

How to Cite:

Fitria, D., Angrella, V., Suciatty, E., & Annisa, M.N. (2025). Problem-Based Learning (PBL) Based E-Worksheets On Digestive System Material To Improve Junior High School Students' Critical Thinking Skills, 13(3): 157-162

INTRODUCTION

Education plays a crucial role in improving the quality of human resources. Well-structured education must be carefully planned to foster an active learning environment and promote meaningful learning experiences (Badin et al., 2019). Learning is a process that is systematically designed, implemented, and evaluated to help students develop critical, logical, accurate, and precise thinking patterns. Nationally, learning is understood as an interactive process involving students, educators, and learning resources within a learning environment. Therefore, the learning process is seen as a system composed of interconnected and interrelated components working together to achieve the intended outcomes optimally, in line with predetermined goals (Harahap et al., 2022). Consequently, the development of thinking skills within science learning becomes essential. Meaningful learning occurs when students are able to connect prior knowledge with newly acquired information. It also allows them to relate previously learned concepts to real-life situations.

The rapid development of science and technology in the 21st century demands students to master not only conceptual knowledge but also high-order thinking skills, particularly critical thinking (Facione, 2011). Moreover, education serves to help students develop their personal potential, particularly in cultivating critical thinking skills—an essential competence in addressing global challenges in today's modern era (Cynthia et al., 2023). Therefore, education serves as a foundational pillar in shaping intelligent, independent, and creative individuals, while simultaneously driving national development.

Critical thinking enables students to analyze, evaluate, and synthesize information to solve complex problems (Ennis, 2015). However, studies show that Indonesian students' critical thinking skills, especially in science subjects, remain relatively low (PISA, 2018).

The Problem-Based Learning (PBL) model offers an effective solution to address these challenges. PBL utilizes real-world problem situations as the context for learning, enabling students not only to understand concepts but also to apply them in solving problems critically and creatively. PBL is a learning model that challenges students to learn how to learn and to work collaboratively in finding solutions to real-life

problems (Aini et al., 2020). Through PBL, students are encouraged to work together, explore information, and develop solutions based on valid data (Fina et al., 2023). This aligns with the goals of science education, which aim not only to instill conceptual understanding but also to develop higher-order thinking skills.

To achieve these goals, appropriate learning media are needed to support the process—one of which is the student worksheet. In today's digital era, the integration of technology in education has become increasingly urgent. One innovation that supports the implementation of PBL is the development of electronic student worksheets (e-worksheets). The development of interactive e-worksheets presents a promising solution. These worksheets not only integrate various multimedia elements such as text, audio, graphics, and video, but also offer flexible access through various electronic devices (Apriyanti, 2024). The e-worksheets are hosted on the *Liveworksheet* website as an accessible learning innovation for both students and teachers, whether via PC or Android devices (Siagian et al., 2022). E-worksheets allow students to engage in more interactive digital learning experiences, reinforcing both conceptual understanding and critical thinking skills. By leveraging technology, e-worksheets can offer a more engaging and relevant learning experience (Lestari, 2023).

Biology, as part of the junior high school science curriculum, provides meaningful opportunities to develop these skills. The digestive system topic, with its real-life relevance, is suitable for applying a Problem-Based Learning (PBL) approach. PBL emphasizes student-centered problem-solving and the development of metacognitive and collaborative skills (Barrows, 1996).

To optimize the PBL implementation, especially in digital or blended learning environments, electronic student worksheets (E-worksheets) offer a strategic alternative. E-worksheets can integrate multimedia, interactive simulations, and hyperlinks to guide students through PBL steps (Rahayu et al., 2022). Thus, the combination of E-worksheets and PBL is expected to foster meaningful learning and improve students' critical thinking abilities.

This study aims to develop a PBL-based E-worksheets on the topic of the human digestive system and to examine its effectiveness in

improving junior high school students' critical thinking skills.

METHODOLOGY

Research Design

This research is a type of Research and Development (R&D) study. Research and Development is a method used to produce a specific product and test its effectiveness (Purnama, 2016). This study was conducted to develop and assess the feasibility of a Problem-Based Learning (PBL)-based electronic student worksheet, involving both content expert validation and media expert validation. The research adopted the ADDIE development model, which includes the following stages: (1) Analysis, (2) Design, (3) Development, (4) Implementation, and (5) Evaluation. However, this study was limited to the first three stages—analysis, design, and development—as it focused solely on producing a feasible product (Simorangkir, 2024).

Two types of data were collected: quantitative data and qualitative descriptive data. Quantitative data consisted of validation scores obtained from validation instruments (questionnaires) completed by media and content experts. Qualitative descriptive data included comments, suggestions, and recommendations provided by the validators regarding the developed electronic worksheet. A Likert scale with a 1–4 interval was used to structure the assessment criteria (Utami et al., 2024). The percentage calculation of the questionnaire results is presented in Table 1.

$$\text{Average Score} = \frac{\text{Total validation score}}{\text{Maximum possible score}} \times 100\%$$

Table 1. Questionnaire Interpretation Criteria

Percentage	Description
<40%	Not Feasible
41% - 60%	Fairly Feasible
61% - 80%	Feasible
81% - 100%	Highly Feasible

RESULTS AND DISCUSSION

This study is a type of research and development that applies the ADDIE instructional design model, developed by Dick & Carey in 1996. The model consists of five phases; however, this research was limited to only three—Analysis,

Design, and Development—due to time and budget constraints. The goal was to produce a feasible product: a Problem-Based Learning (PBL) digital worksheet for the digestive system topic aimed at enhancing junior high school students' critical thinking skills.

Analysis

Curriculum and Needs Analysis

This phase involved analyzing the curriculum and learning needs to ensure the digital worksheet aligned with educational objectives for the digestive system topic at the junior high school level. Observations indicated that conventional worksheets were still widely used and lacked interactivity, failing to engage students in meaningful critical thinking. These materials primarily focused on content delivery and drills, without incorporating real-life problem-solving tasks. Hence, developing a PBL-based digital worksheet was considered essential to provide a more dynamic learning experience, foster critical thinking, and connect concepts to real-world situations. Through the PBL approach, the worksheet was designed to support contextual and relevant learning that responds to 21st-century educational demands.

Design

The PBL-based digital worksheet was designed using *Canva* for content creation and *Liveworksheet* for deployment. The completed worksheet was uploaded to the *Liveworksheet* platform (Safitri et al., 2022).

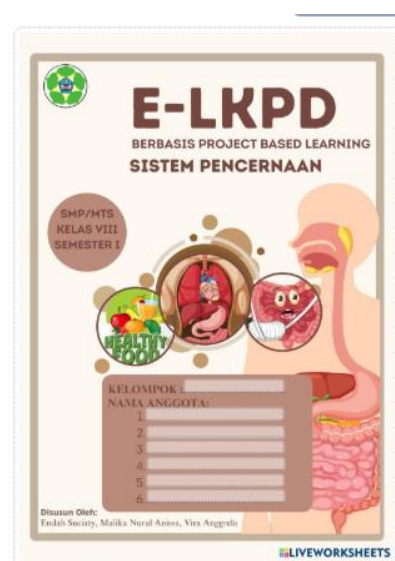


Figure 1. Cover of the PBL-based worksheet



Figure 2. User instructions in the PBL-based worksheet

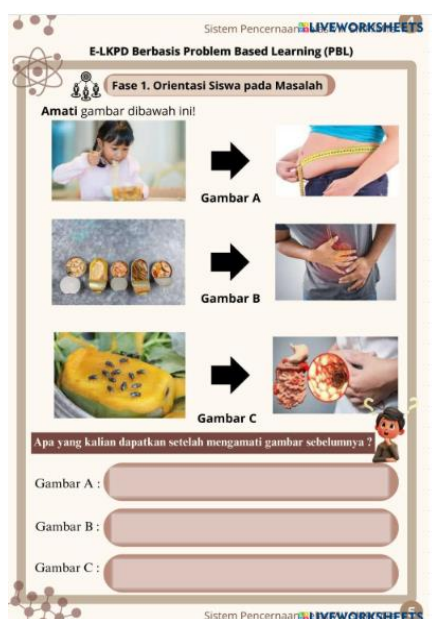


Figure 3. Content view of the PBL-based worksheet

The design was guided by the five key stages of the Problem-Based Learning model:

1. **Orienting Students to the Problem**
The worksheet presents a real-world issue relevant to the digestive system, such as unhealthy eating habits and their effects on digestive organs, illustrated through

engaging images to spark students' curiosity and interest in solving the problem.

2. **Organizing Students for Learning**
Teachers play a key role in facilitating student engagement by clearly explaining tasks and enabling effective collaboration.
3. **Guiding Individual or Group Investigation**
The worksheet directs students to conduct investigations, such as simple experiments or researching information. It includes features like data tables, evidence submission sections, and guided questions to support analysis.
4. **Developing and Presenting Work**
Students are encouraged to create solutions or products from their findings, such as informational materials or presentations. The worksheet provides templates for these outputs.
5. **Analyzing and Evaluating the Problem-Solving Process**
This stage invites student reflection on the learning process, challenges encountered, and future improvements. Reflection templates are provided, allowing students to assess and give feedback on their proposed solutions.

This design not only facilitates content mastery but also develops students' critical thinking, problem-solving, and collaboration skills—aligned with 21st-century competencies.

Development

In this phase, the PBL-based digital worksheet on the digestive system was tested and validated. A biology education lecturer from Universitas Samudra served as the expert validator, evaluating both content and media using structured validation sheets. Feedback and suggestions were incorporated to revise and improve the product. Once declared feasible, the worksheet was ready to be used as a learning tool to enhance students' critical thinking skills. The revised version can be accessed via this link: <https://www.liveworksheets.com/...>

Expert Validation of Media and Content

The development phase of the PBL-based E-Worksheet on the digestive system material

included validation by media and content experts to ensure the quality and feasibility of the product. The media expert validation yielded an average score percentage of 77.7%, categorized as “*feasible with revisions*.” The expert highlighted the need for improvement in the use of supporting images within the E-Worksheet, noting that some visuals were not appropriately aligned with the content or overall design objectives. This indicates that while the technical aspects and interactivity were generally acceptable, visual congruence remains a critical factor in media-based learning tools (Mayer, 2009).

On the other hand, the content (material) expert validation produced a score percentage of 69.4%, which also falls under the “*feasible with revisions*” category. The revisions suggested by the expert included enhancements to learning indicators, the selection and clarity of images, and the inclusion of more relevant videos to support the Problem-Based Learning (PBL) approach used in the E-LKPD. These findings reflect the importance of aligning digital learning materials with the core principles of PBL, which emphasize contextualized problems, multimedia learning resources, and scaffolding to support student inquiry (Hmelo-Silver, 2004; Barrows, 1996).

Feasibility of PBL-Based E-LKPD Development

Based on these validation results, it can be concluded that the developed E-LKPD is *feasible to be tested* in the classroom setting. The media and content evaluations provide constructive input for refinement, particularly in optimizing multimedia elements to enhance students’ cognitive engagement. According to Aloraini (2012), well-designed instructional media significantly influence student learning outcomes, especially when integrated with active learning strategies like PBL.

However, this study was limited to the development phase. Therefore, the effectiveness and practicality of the developed E-LKPD were not tested in a classroom setting. Further research is needed to conduct empirical testing of the product in actual learning environments to evaluate its impact on students’ critical thinking skills. Future studies should adopt experimental or quasi-experimental methods to determine learning gains and user satisfaction (Sugiyono, 2015).

PBL can foster higher-order thinking through problem orientation, collaborative learning, and reflection (Hmelo-Silver, 2004). The

use of digital media in E-worksheets enhanced students’ engagement and autonomy in learning, aligning with the expectations of digital-native learners (Pratama & Solehuddin, 2020).

CONCLUSION

Based on the results of the research and development of a Problem-Based Learning (PBL)-based electronic worksheet on the topic of the digestive system, it can be concluded that the developed product is feasible for use in junior high school learning. The worksheet was successfully designed to support more interactive learning and to encourage students to think critically by engaging them in solving problems relevant to real-life situations. Validation by content and media experts indicated that the worksheet met the criteria for feasibility, although some revisions were still needed—particularly in the supporting visuals and learning indicators. Although this study was limited to the development stage, the results demonstrate the significant potential of the PBL-based worksheet to improve junior high school students’ critical thinking skills. Therefore, further research is necessary to evaluate the effectiveness and practicality of implementing this worksheet in the classroom.

REFERENCES

- Aloraini, S. (2012). *The impact of using multimedia on students’ academic achievement in the College of Education at King Saud University*. Journal of King Saud University - Languages and Translation, 24(2), 75–82. <https://doi.org/10.1016/j.jksult.2012.05.02>
- Apmiyanti, T., & Yerimadesi, Y. (2024). Validitas Dan Praktikalitas E-Lkpd Interaktif Berbasis Guided Discovery Learning Berbantuan Liveworksheet Pada Materi Hidrokarbon Untuk Fase F SMA. *SCIENCE: Jurnal Inovasi Pendidikan Matematika dan IPA*, 4(4), 431-438. DOI: <https://doi.org/10.51878/science.v4i4.3492>
- Badin, I., Sahjat, S., & Muhammad, N. (2019). Pengaruh Model Pembelajaran Kooperatif Tipe Talking Stick terhadap Hasil Belajar Siswa Kelas VIII-C SMP Negeri 7 Kota Ternate pada Konsep Getaran dan Gelombang. *SAINTIFIK@: Jurnal Pendidikan MIPA*, 4(2).

- Barrows, H. S. (1996). *Problem-based learning in medicine and beyond: A brief overview*. New Directions for Teaching and Learning, 68, 3–12.
- Cynthia, R. E., & Sihotang, H. (2023). Melangkah bersama di era digital: pentingnya literasi digital untuk meningkatkan kemampuan berpikir kritis dan kemampuan pemecahan masalah peserta didik. *Jurnal Pendidikan Tambusai*, 7(3), 31712-31723.
- Ennis, R. H. (2015). *Critical thinking: A streamlined conception*. In M. Davies & R. Barnett (Eds.), *The Palgrave Handbook of Critical Thinking in Higher Education* (pp. 31–47). Palgrave Macmillan.
- Facione, P. A. (2011). *Critical Thinking: What It Is and Why It Counts* (2011 Update). Insight Assessment.
- Fina, I. D., Mustaji, M., & Dewi, U. (2023). Analisis Kebutuhan e-LKPD Berbasis Problem Based Learning Terhadap Pembelajaran IPA SMP Kelas VIII. *Oryza (Jurnal Pendidikan Biologi)*, 12(2), 173-181. DOI: <https://doi.org/10.33627/oz.v2i2.1379>
- Harahap, N.A., Masruro, Z., Saragih, S.Z., Hasibuan, R., Simamora, S.S., & Toni, T. (2022). Buku Ajar Belajar dan Pembelajaran. Widina Bhakti Persada; Bandung.
- Hmelo-Silver, C. E. (2004). *Problem-based learning: What and how do students learn?* Educational Psychology Review, 16(3), 235–266.
- Lestari, D. I., & Kurnia, H. (2023). Implementasi model pembelajaran inovatif untuk meningkatkan kompetensi profesional guru di era digital. *JPG: Jurnal Pendidikan Guru*, 4(3), 205-222.
- Mayer, R. E. (2009). *Multimedia Learning* (2nd ed.). Cambridge University Press.
- PISA. (2018). *Results from PISA 2018*. OECD Publishing. <https://www.oecd.org/pisa/publications/pisa-2018-results.htm>
- Pratama, H., & Solehuddin, M. (2020). *E-LKPD Development with PBL Model to Improve Critical Thinking Skills of High School Students*. Journal of Science Education, 4(2), 100–110.
- Rahayu, S., Widodo, A., & Setiawan, W. (2022). *Designing Interactive Worksheets Based on Problem-Based Learning to Support Science Education in the Digital Age*. Journal of Education and Learning, 11(1), 45–56.
- Siagian, G., Sirait, D. E., Situmorang, M. V., & Silalahi, M. V. (2022). Pengembangan e-LKPD berbasis etnosains untuk melatih keterampilan literasi sains pada materi zat makanan. *Jurnal Penelitian Dan Pengabdian Masyarakat Nommensen Siantar*, 2(2), 63-87.
- Simorangkir, M. (2024). Pengembangan e-LKPD Kimia Berbasis Problem Based Learning Pada Materi Laju Reaksi Sesuai Kurikulum Merdeka. *Didaktika: Jurnal Kependidikan*, 13(2), 2241-2252.
- Sugiyono. (2015). *Metode Penelitian Pendidikan (Pendekatan Kuantitatif, Kualitatif dan R&D)*. Bandung: Alfabeta
- Utami, P. D., Saputra, J., Pramudiyanti, P., & Dewi, P. S. (2024). Pengembangan E-LKPD pada Pembelajaran IPA di Kelas V Sekolah Dasar. *Jurnal Ilmu Pendidikan Islam*, 22(03), 380-391. DOI: <https://doi.org/10.36835/jipi.v24i03.4271>