

Development of Student Worksheets Using a Deep Learning Approach for Ecosystem and Environmental Diversity

Ilmi Zajuli Ichsan^{1*}, Inggit Woro Safitri¹, Fauza Agustina¹, Tini¹, Ester Monita Widyawati¹, Susi Barini¹, Widyastanti¹, Tri Hendrawati¹, Rif'ah¹, Susanti Meytiyasari¹

¹Pendidikan Guru Sekolah Dasar, Fakultas Keguruan dan Ilmu Pendidikan, Universitas Mohammad Husni Thamrin, Indonesia

*Correspondence email: ilmizajuli95@gmail.com

ABSTRAK

Pembelajaran lingkungan hidup pada jenjang Sekolah Dasar mengutamakan proses ketelitian dan ketepatan dalam pembahasan topik. Pendekatan deep learning dianggap sebagai sebuah Solusi dari dangkalnya pemahaman siswa terkait dengan lingkungan hidup. Salah satu yang berdampak Adalah terkait dengan topik keanekaragaman ekosistem dan lingkungan. Tujuan dari penelitian ini Adalah untuk mengembangkan lembar kerja siswa dengan pendekatan deep learning dalam topik keanekaragaman ekosistem dan lingkungan. Metode yang digunakan dalam penelitian ini Adalah research and development (R&D) dengan pendekatan tahapan pengembangan ADDIE. Hasil dari penelitian ini menunjukkan bahwa LKS yang sudah dikembangkan memiliki kategori sangat valid (skor diatas 80%) sehingga layak digunakan dalam pembelajaran. Adapun untuk di masa yang akan datang, produk LKS yang dikembangkan dapat untuk diteruskan pada tahapan implementasi dan evaluasi untuk mengukur efektivita dari LKS yang dikembangkan.

ABSTRACT

Environmental learning at the elementary school level prioritizes thoroughness and accuracy in discussing topics. The deep learning approach is considered a solution to students' shallow understanding of the environment. One of the impacts is related to the topic of ecosystem and environmental diversity. The purpose of this study is to develop student worksheets with a deep learning approach on the topic of ecosystem and environmental diversity. The method used in this study is research and development (R&D) with the ADDIE development stage approach. The results of this study indicate that the developed worksheets have very valid categories (Score above 80%) and are therefore suitable for use in learning. As for the future, the developed worksheet products can be continued to the implementation and evaluation stages to measure the effectiveness of the developed worksheets.

ARTICLE HISTORY

Received 3 February 2026

Accepted 8 August 2026

KEYWORDS

deep learning; student worksheets; environment; ecosystem diversity

HOW TO CITE:

Ichsan et al. (2026). Development of Student Worksheets Using a Deep Learning Approach for Ecosystem and Environmental Diversity. Jurnal Al-Ahya, 8(2), 59–65. <https://doi.org/10.24252/al-ahya.v7i2>

Introduction

Education in the 21st century requires continuous innovation in instructional approaches to support the development of students' competencies. One promising approach is deep learning, which emphasizes the development of profound and comprehensive understanding rather than superficial knowledge acquisition. Deep learning seeks to actively engage students in the learning process,

enabling them to construct meaningful knowledge and develop higher levels of understanding (Kharisma et al., 2025; Muvid, 2024; Zain & Akbar, 2025). Deep learning-oriented education also emphasizes active student participation and meaningful communication between teachers and students. These characteristics highlight the importance of implementing and further developing deep learning approaches to address the demands of 21st-century education.

The instructional materials used in the learning process also need to be improved, particularly in terms of the use of student worksheets. Instructional materials play an important role in supporting more comprehensive learning experiences. Student worksheets are instructional tools that contain learning-related guidance and instructions, ranging from the initial stages of learning activities to the presentation of subject-matter content (Ama & Mistianah, 2018; Sukimarwati et al., 2013). Student worksheets can guide students to participate more actively in the learning process, including in the implementation of deep learning-oriented instruction. Integrating deep learning principles into student worksheets can facilitate the learning process while promoting deeper and more comprehensive understanding. A distinctive feature of student worksheets integrated with deep learning is the inclusion of joyful, mindful, and meaningful learning activities. These principles are incorporated into the worksheets through structured learning activities and instructional guidance.

Various studies on the development of innovative instructional approaches have previously been conducted, including the development of the Cooperative Integrated Reading and Composition based on Scientific Approach (CIRSA) learning model (Djamahar et al., 2018, 2019). This model emphasizes learning processes that foster students' critical thinking skills. Other studies have focused on the development of student worksheets based on a project-based learning approach (Santoso et al., 2021; Sari et al., 2021). These worksheets have demonstrated considerable potential for improving the quality of students' learning experiences. The integration of innovation into student worksheets is therefore necessary to enhance students' access to increasingly open sources of information and to respond to the evolving demands of contemporary education.

One relevant issue that can be addressed through the integration of student worksheets is ecosystem and environmental diversity. This topic is essential for students to explore due to the increasing prevalence of environmental degradation. One potential strategy for addressing these challenges is through education. In this context, educational efforts can be strengthened by developing student worksheets based on a deep learning approach. This approach is considered relevant because one of the major challenges encountered in the learning process is students' limited ability to develop a thorough and contextual understanding of the subject matter. Therefore, a deep learning approach is important to promote more meaningful and comprehensive learning. Based on these considerations, this study focuses on developing student worksheets incorporating a deep learning approach for the topic of ecosystem and environmental diversity.

Methodology

This study employed a research and development (R&D) method using the Analyze, Design, Develop, Implement, and Evaluate (ADDIE) model (Branch, 2009). The ADDIE model was selected because it provides a relatively concise and systematic development process that focuses directly on the essential stages of instructional product development. Other development models, such as Borg and Gall or Dick and Carey, were not adopted because they involve more extensive and complex procedural stages. The study was conducted at Mohammad Husni Thamrin University in 2025. The stages of the ADDIE model implemented in this study are illustrated in the flowchart presented in the following figure 1.

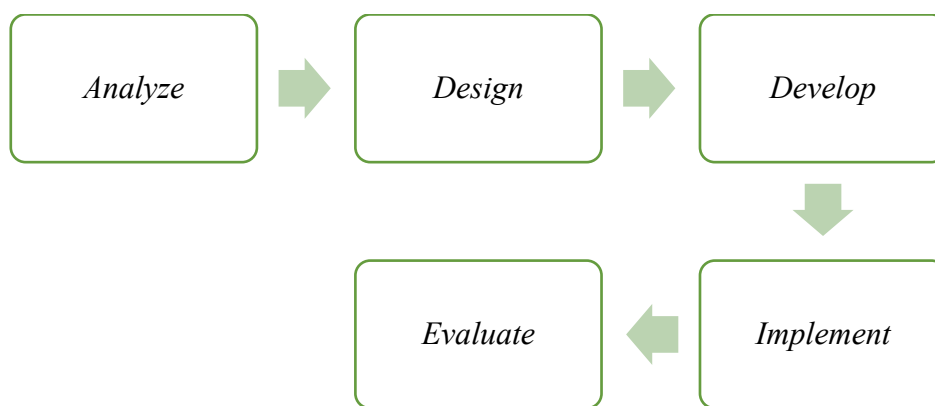


Figure 1. Flowchart of the Research and Development Stages Using the ADDIE Model

The first stage involved analyzing the need for student worksheets at the elementary school level. The results of the needs analysis were then used as the basis for the second stage, namely designing student worksheets based on a deep learning approach for the topic of ecosystem and environmental diversity. The subsequent stage focused on developing the student worksheet product. At this stage, the developed worksheets were also subjected to expert validation by specialists in learning and instruction. The results of the student worksheet validation were then interpreted according to the criteria presented below.

Table 1

Validation Criteria for the Student Worksheet

Score Percentage	Category	Feasibility Description
81 % - 100%	Highly Valid	Can be used without revision
61 % - 80%	Valid	Can be used with minor revisions
41 % - 60%	Less Valid	Can be used with major revisions
21 % - 40%	Invalid	Not suitable for use
0% - 20%	Invalid	Not suitable for use

Source: (Akbar, 2013)

The implementation and evaluation stages of the developed student worksheet were not conducted in this study due to limitations in the scope and time available for carrying out these stages. Therefore, this study focused exclusively on the Analyze, Design, and Develop stages of the ADDIE model. The results of the expert validation were subsequently used to determine whether the developed student worksheet was feasible and appropriate for use in the learning process.

Results and Discussion

The findings of this study indicate that the needs analysis revealed the absence of adequate student worksheets at the school. The design of the student worksheet developed in this study was therefore based on the identified instructional needs. The analysis showed that the worksheet should incorporate key elements of deep learning, namely joyful, meaningful, and mindful learning. One of the deep learning-oriented activities included in the worksheet requires students to explore the school surroundings and record the characteristics of the ecosystems they observe, including their biotic and abiotic components. This activity was considered appropriate for fostering joyful, mindful, and meaningful learning experiences. The resulting student worksheet developed in this study is presented in Figure 2.

**LEMBAR KERJA SISWA
BERBASIS DEEP LEARNING
KEANEKARAGAMAN EKOSISTEM DAN LINGKUNGAN**

Nama :
Kelas :

Pergilah ke sekeliling sekolah dan lihatlah berbagai ekosistem dan komponen abiotik dan biotik di ekosistem tersebut

Karakteristik Ekosistem:
.....
.....
.....
.....

Komponen Biotik:
.....
.....
.....
.....

Komponen Abiotik:
.....
.....
.....
.....

Figure 2. Deep Learning-Based Student Worksheet on Ecosystem and Environmental Diversity

The developed deep learning-based student worksheet was subsequently validated by an expert in learning and instruction. The validation results indicated that the worksheet met the criteria for the valid category and was therefore considered feasible for use in the learning process.

The validation assessed two main aspects: the presentation of the worksheet and the language used throughout the worksheet. The detailed results of the expert validation are presented in Table 2.

Table 2

Results of Student Worksheet Validation by an Instructional Expert

No	Validator	Score	Category
1	Instructional Expert I	87.50%	Highly Valid
2	Instructional Expert I	90.00%	Highly Valid

The expert validation results indicated that the developed student worksheet was feasible for use in the learning process. This study was limited to the development stage, while the subsequent implementation and evaluation stages were not conducted. The developed worksheet offers several advantages, particularly its integration with a deep learning approach. This integration is reflected in the instructions and learning activities included in the worksheet, such as guiding students to explore the school surroundings to observe existing ecosystems and environmental conditions. The deep learning-oriented activities incorporated into the worksheet make the learning process more relevant to students' immediate environmental context, which may contribute to more meaningful environmental learning. The integration of deep learning principles into instructional activities can also facilitate deeper understanding and enhance the overall quality of the learning process (Purba & Dewayanto, 2023; Zain & Akbar, 2025).

Activities closely associated with deep learning-oriented instruction are those that promote engaging and meaningful learning experiences, commonly characterized as joyful, mindful, and meaningful learning. These three principles represent key features of deep learning, which emphasizes an integrated and comprehensive learning process. Accordingly, joyful, mindful, and meaningful learning should be reflected in instructional practices that adopt a deep learning approach. These principles should also be embedded in 21st-century learning to enhance the quality of students' learning experiences (Berland et al., 2016; Panno et al., 2018; Supriyatin et al., 2016). The development of this student worksheet is therefore important for supporting environmental learning that is relevant to contemporary educational needs.

Environmental education addressing ecosystems and environmental issues needs to be continuously strengthened to support more comprehensive learning for the future. Consistent implementation of environmental learning can contribute positively to education by aligning learning experiences with the competencies required in the 21st century. Four key competencies are particularly important in 21st-century learning: critical thinking, creativity, communication, and collaboration (Boulden, 2021; Rogayan Jr et al., 2021; Talmi et al., 2018; Urbani et al., 2017). These competencies need to be developed from an early stage, including at the elementary school level. Environmental learning in elementary education is particularly important because this stage provides a foundation for instilling essential values, awareness, and responsibility related to the environment.

Environmental education should ensure the relevance of the topics addressed within the educational context. In this regard, relevance refers to the extent to which environmental learning incorporates issues that are closely connected to students' learning contexts, thereby supporting more contextual and meaningful classroom discussions. Learning materials that lack relevance may lead to confusion when the content does not correspond to students' needs or the intended learning context. The topic of ecosystem and environmental diversity is therefore highly appropriate for 21st-century learning, which emphasizes alignment between learning content and the competencies students are expected to develop. Accordingly, the student worksheet developed in this study is expected to have a positive impact on students' learning experiences and understanding.

Conclusion

Based on the findings of this study, the developed student worksheet was categorized as highly valid and was therefore considered feasible for use in the learning process. A limitation of the developed worksheet is that the implementation and evaluation stages were not conducted; consequently, its effectiveness in improving learning outcomes could not yet be comprehensively assessed. Nevertheless, the development of this worksheet responds to the need for innovative and creative learning materials that are aligned with contemporary educational demands and support the development of 21st-century competencies. Future research is recommended to further develop and implement more comprehensive and integrative student worksheets that connect learning across relevant sectors and contexts.

References

- Akbar, S. (2013). Instrumen Perangkat Pembelajaran (Anwar Holid. In *PT. Remaja Rosdakarya*. PT. Remaja Rosdakarya.
- Ama, S. T. A., & Mistianah, M. (2018). Pengembangan Lembar Kerja Siswa (Lks) Berbasis Poe Predict Observe Explain Pada Materi Sistem Pencernaan Dan Pernapasan Pada Manusia Di Kelas Xi Sma. *Edubiotik: Jurnal Pendidikan, Biologi Dan Terapan*, 3(02), 19–22. <https://doi.org/10.33503/ebio.v3i02.171>
- Berland, L. K., Schwarz, C. V., Krist, C., Kenyon, L., Lo, A. S., & Reiser, B. J. (2016). Epistemologies in practice: Making scientific practices meaningful for students. *Journal of Research in Science Teaching*, 53(7), 1082–1112. <https://doi.org/10.1002/tea.21257>
- Boulden, R. (2021). Developing 21st-Century Skills through Restorative Practices. *The Clearing House: A Journal of Educational Strategies, Issues and Ideas*, 94(5), 205–215. <https://doi.org/10.1080/00098655.2021.1915740>
- Branch, R. M. (2009). Instructional design: The ADDIE approach. In *Department of Educational Psychology and Instructional Technology University of Georgia* (Vol. 53, Number 9). Springer.
- Djamahar, R., Ristanto, R. H., Sartono, N., Ichsan, I. Z., Darmawan, E., & Muhlisin, A. (2019). Empowering Student's Metacognitive Skill through Cirs Learning. *Journal of Physics: Conference Series*, 1227(1), 012001. <https://doi.org/10.1088/1742-6596/1227/1/012034>

- Djamahar, R., Ristanto, R. H., Sartono, N., Ichsan, I. Z., & Muhlisin, A. (2018). CIRSA: Designing Instructional Kits to Empower 21st Century Skill. *Educational Process: International Journal*, 7(3), 200–208. <https://doi.org/10.22521/edupij.2018.73.4>
- Kharisma, N., Septiani, D. E., & Suryaningsih, F. (2025). Transformasi pembelajaran bermakna melalui deep learning: Kajian literatur dalam kerangka kurikulum merdeka. *Al-Zayn: Jurnal Ilmu Sosial & Hukum*, 3(3), 1895–1905.
- Muvid, M. B. (2024). Menelaah wacana kurikulum deep learning: urgensi dan peranannya dalam menyiapkan generasi emas Indonesia. *Jurnal Edu Aksara*, 3(2), 80–93.
- Panno, A., Giacomantonio, M., Carrus, G., Maricchiolo, F., Pirchio, S., & Mannetti, L. (2018). Mindfulness, Pro-environmental Behavior, and Belief in Climate Change: The Mediating Role of Social Dominance. *Environment and Behavior*, 50(8), 864–888. <https://doi.org/10.1177/0013916517718887>
- Purba, K. A., & Dewayanto, T. (2023). Penerapan artificial intelligence, machine learning dan deep learning pada Kurikulum Akuntansi-A systematic literature review. *Diponegoro Journal of Accounting*, 12(3).
- Rogayan Jr, D. V, Gallardo, C. B., Lacaste, J. T., & Roque, D. J. A. (2021). 21st-Century Skills of Social Studies Students: Basis for a Proposed Training Program. *International Journal of Multidisciplinary: Applied Business and Education Research*, 2(2), 195–205. <https://doi.org/https://doi.org/10.11594/ijmaber.02.02.08>
- Santoso, A. M., Primandiri, P. R., Zubaidah, S., & Amin, M. (2021). The development of students' worksheets using project based learning (PjBL) in improving higher order thinking skills (HOTS) and time management skills of students. *Journal of Physics: Conference Series*, 1806(1). <https://doi.org/10.1088/1742-6596/1806/1/012173>
- Sari, D. S., Widiyawati, Y., Nurwahidah, I., Masykuri, M., & Budiyanto, C. W. (2021). *The Development of E-Worksheet Based on Project to Promote Student's Creative Thinking and Digital Literacy Skills*. <https://doi.org/10.2991/assehr.k.210305.094>
- Sukimarwati, J., Widha, S., & Sugiyarto, S. (2013). Pembelajaran Biologi dengan Guided Inquiry Model Menggunakan LKS Terbimbing dan LKS Bebas Termodifikasi Ditinjau Dari Kreativitas dan Motivasi Berprestasi Siswa. *Jurnal Inkuiri*, 2, 154–162.
- Supriyatin, S., Nurnawati, N., & Heryanti, E. (2016). Pengaruh Penerapan Active, Joyful, And Effective Learning (AJEL) Pada Materi Perubahan Lingkungan Terhadap Sikap Peduli Lingkungan Siswa. *Biosfer: Jurnal Pendidikan Biologi*, 9(2), 69–75. <https://doi.org/10.21009/biosferjpb.9-2.10>
- Talmi, I., Hazzan, O., & Katz, R. (2018). Intrinsic motivation and 21st-century skills in an undergraduate engineering project: the formula student project. *Higher Education Studies*, 8(4), 46. <https://doi.org/10.5539/hes.v8n4p46>
- Urbani, J. M., Truesdell, E., Urbani, J. M., Roshandel, S., Michaels, R., & Truesdell, E. (2017). Developing and modeling 21st-century skills with preservice teachers. *Teacher Education Quarterly*, 44(4), 27–51.
- Zain, M., & Akbar, M. S. (2025). Pemanfaatan Deep Learning dalam Kurikulum Pembelajaran Abad 21: Sebuah Tinjauan Literatur. *SISFOTENIKA*, 15(2), 209–218.