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The Effect of Project-Based Learning Model Assisted by Flipbook Media to Improve Students' Scientific Literacy Skills on Environmental Change and Conservation Material

Millata Hanifa, Nur Rahayu Utami✉

[1]Departement of Biology, Faculty of Mathematics and Natural Sciences, Semarang State University, Indonesia

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Abstract

A preliminary study conducted with Grade XI students at MAN Kendal through observations and interviews revealed that students had not yet developed adequate scientific literacy skills. This was evident in their limited ability to analyze and articulate ideas related to solving environmental problems, identify types of waste that cause pollution, predict the negative impacts of pollution, design waste management strategies, and carry out recycling. Given the importance of scientific literacy, this study aimed to improve these skills through the application of a project-based learning model supported by flipbook media. The research employed a quasi-experimental method with a nonequivalent control group design. The sample consisted of classes XI A and XI B, selected using purposive sampling. The research instruments included tests, observation sheets, and peer assessment forms. The findings indicated that 90% of students achieved N-gain scores in the medium to high category. The Wilcoxon test further confirmed significant differences in scientific literacy skills before and after the implementation of project-based learning with flipbook media. Data from observations and peer assessments showed that students' scientific literacy achievements reached 74% in context (science application), 90% in content (scientific knowledge), 70% in competence (scientific process), and 90% in attitude. The study concludes that the project-based learning model supported by flipbook media is effective in improving students' scientific literacy on the topic of environmental change and conservation, with a good level of achievement throughout the project implementation.

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✉**Correspondence Address:**
D6 Building, Faculty of Mathematics and Natural Sciences (FMIPA), Sekaran, Gunungpati, Semarang, 50229

E-mail: utaminurrahayu733@gmail.com

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INTRODUCTION

Education serves to develop human resources who are skilled, productive, and environmentally conscious. Through environmental education, individuals are expected to preserve nature, as they inherently interact with and influence their surroundings (Neolaka, 2008). The cultivation of environmental awareness can begin at school; however, classroom practices often fail to support this goal, making effective learning approaches necessary. Scientific literacy can be defined as the ability to understand science, communicate science (both orally and in writing), and apply scientific knowledge to solve problems, thereby fostering a high level of sensitivity and responsibility in making decisions based on scientific considerations.

Scientific literacy skills influence students' learning outcomes, as learning outcomes are generally affected by the understanding of a learning concept and the ability to solve problems within the learning process (Nisa et al., 2020). A variety of tasks that involve multiple problems require students to apply their scientific literacy skills in analyzing issues, formulating ideas, and constructing arguments (Firdaus et al., 2018). Scientific literacy is characterized by four dimensions: competence (scientific processes), content (scientific knowledge), and context (application of science).

Biology at the senior high school level is a strategic subject because it equips students with scientific and technological knowledge, as well as critical, creative, and logical thinking skills, while fostering their ability to communicate and collaborate. Scientific literacy encompasses the understanding, communication, and application of science in solving problems. According to the Organization for Economic Co-operation and Development (OECD), Indonesia's science literacy score in the Programme for International Student Assessment (PISA) 2022 declined compared to 2018. In 2022, Indonesia's science literacy score reached 366 points, lower than the 379 points obtained in 2018. Furthermore, Indonesia's reading literacy score in 2022 (371 points) was also lower compared to the score achieved in 2000.

The topic "Environmental Change and Conservation" in Grade XI requires students to embody the characteristics of Pelajar Pancasila—critical thinking, independence, and creativity. The learning objectives include identifying environmental changes and pollution, recognizing the causes and impacts of pollution, analyzing waste management strategies, and designing recycling projects. A project-based learning model is well-suited to achieving these objectives because it promotes collaboration, creativity, and experimentation. Pratama et al. (2018) state that project-based learning is more effective than lecture or demonstration methods in developing personal, social, academic, and vocational skills. Based on Decree No. 033/H/KR/2022 regarding learning outcomes in the Merdeka Curriculum, the environmental change topic includes aspects of environmental pollution and the management of organic and inorganic waste. The project-based learning approach reviewed in this module involves the analysis of organic and inorganic waste management. By focusing on this type of project-based learning, students can be encouraged to develop stronger environmental awareness.

Advances in technology have made students more inclined to focus on the digital world and less sensitive to environmental issues (Marjohan & Afniyanti, 2018). Early education can play a crucial role in fostering awareness of environmental conservation (Uno, 2021; Indra & Fitria, 2021). Utilizing the environment as a learning resource is also important to anticipate the impacts of environmental change, including waste management (Saparuddin et al., 2022). During their school years, students are often eager to explore their surroundings; this curiosity generates strong motivation and the potential to initiate changes in their environment (Indra & Fitria, 2021). Such curiosity encourages teachers to innovate by designing learning activities that foster a love for the environment.

The preliminary study conducted at MAN Kendal revealed that students were not yet able to analyze environmental problems, identify types of waste, predict the impacts of pollution, or design solutions for waste management. Teaching methods were still dominated by lectures, discussions, and question-and-answer sessions, which led to student passivity and low scientific literacy skills. Project-based learning is expected to enhance these skills because it involves collaborative work, independent discovery, and active student engagement (Nielsen, 2012). Based on these conditions, this study is entitled "The Effect of a Project-Based Learning Model Assisted by Flipbook Media to Improve Students' Scientific Literacy Skills on Environmental Change and Conservation."

RESEARCH METHODOLOGY

This study was conducted at MAN Kendal. The research method applied was a pre-experimental design using the one-group pretest–posttest model. The study population included all Grade XI students at MAN Kendal, comprising two classes. The sample consisted of classes XI-I and XI-H, with a total of 70 students, selected through purposive sampling. The data used in this study included test results, observations, and students' responses to the learning process. The data sources were the students themselves. Data collection techniques included tests, observations, and documentation. Test results were analyzed using N-gain calculations and inferential statistics, while observational data were analyzed using the Wilcoxon test. Student responses and the implementation of learning were analyzed descriptively using quantitative methods.

RESULTS AND DISCUSSION

Students' scientific literacy skills before and after the use of a project-based learning model supported by flipbook media were measured through pretest and posttest items. The test consisted of 10 open-ended questions.

Scientific Literacy in the Context Aspect (Application of Science)

The results showed that out of 70 students, 18 achieved gains in the high category, 34 in the medium category, and 18 in the low category. Based on Figure 4.1, it can be seen that 74% of students achieved gains in the medium to high category. In relation to this, the Wilcoxon test was conducted to determine whether there was a significant difference before and after treatment.

Table 1. Wilcoxon Test Results for K1 (Application of Science)

Test Statistics[a]

	Post_K1 - Pre_K1
Z	-7.216[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

Based on Table 1, the Asymp. Sig. (2-tailed) value was 0.000 < 0.05, meaning that H_0 was rejected and H_a accepted. This indicates a significant difference in science application scores (K1) before and after treatment. The difference observed was an increase in scores after treatment, with 52 out of 70 students scoring higher on the posttest compared to the pretest.

Scientific Literacy in the Content Aspect (Scientific Knowledge)

The results showed that out of 70 students, 13 achieved gains in the high category, 51 in the medium category, and 6 in the low category. Based on Figure 4.2, 91% of students achieved gains in the medium to high category. Again, the Wilcoxon test was applied to determine whether there was a significant difference.

Table 2. Wilcoxon Test Results for K2 (Scientific Knowledge)

Test Statistics[a]

	Post_K2 - Pre_K2
Z	-7.373[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

Based on Table 2, the Asymp. Sig. (2-tailed) value was 0.000 < 0.05, meaning that H_0 was rejected and H_a accepted. This indicates a significant difference in scientific knowledge scores (K2) before and after treatment. The increase is shown by 64 out of 70 students obtaining higher posttest scores than pretest scores.

Scientific Literacy in the Competence Aspect (Scientific Process)

The results showed that out of 70 students, 21 achieved gains in the high category, 42 in the medium category, and 7 in the low category. Based on Figure 4.3, 70% of students achieved gains in the medium to high category. The Wilcoxon test was again applied to confirm the significance of the difference.

Table 3. Wilcoxon Test Results for K3 (Scientific Process)

Test Statistics[a]

	Post_K3 - Pre_K3
Z	-7.281[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

Based on Table 3, the Asymp. Sig. (2-tailed) value was 0.000 < 0.05, indicating that H_0 was rejected and H_a accepted. This shows a significant difference in scientific process scores (K3) before and after treatment. The difference was an increase, with 63 out of 70 students achieving higher posttest scores than pretest scores.

Scientific Literacy in the Attitude Aspect

The results showed that out of 70 students, 29 achieved gains in the high category, 34 in the medium category, and 7 in the low category. Based on Figure 4.4, 90% of students achieved gains in the medium to high category.

Table 4. Wilcoxon Test Results for K4 (Attitude)

Test Statistics[a]

	Post_K4 - Pre_K4
Z	-5.215[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

Based on Table 4, the Asymp. Sig. (2-tailed) value was 0.000 < 0.05, meaning that H_0 was rejected and H_a accepted. This indicates a significant difference in student attitude scores (K4) before and after treatment. The improvement was evident as 63 out of 70 students had higher posttest scores than pretest scores.

Overall Scientific Literacy Skills

The results showed that out of 70 students, 29 achieved gains in the high category, 34 in the medium category, and 7 in the low category. Thus, it can be concluded that 90% of students achieved gains in the medium to high category

Table 5. Wilcoxon Test Results for Overall Scientific Literacy

Test Statistics[a]

	Posttest_Total - Pretest_Total
Z	-7.291[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

Based on Table 5, the Asymp. Sig. (2-tailed) value was 0.000 < 0.05, indicating that H_0 was rejected and H_a accepted. This suggests a significant overall improvement in scientific literacy scores before and after treatment. The difference was an increase, with 63 students obtaining higher posttest scores compared to pretest scores. This means both effectiveness indicators were met, showing that the project-based learning model supported by flipbook media was effective in improving students' scientific literacy across the aspects of context (application of science), content (scientific knowledge), competence (scientific process), and attitude.

Students' Scientific Literacy Skills During Project Implementation

The integration of project-based learning with flipbook media was reflected in systematically structured group assignments based on the project-based learning syntax, which includes posing questions at the beginning of learning, planning project activities, scheduling project tasks, monitoring project implementation, assessing the project, and conducting project evaluations. During the project, 70 students

were divided into 18 groups, each consisting of 5–6 members. The project tasks guided students to produce a final product in the form of a project report supported by project videos. Based on the preparation of group project reports, students' scientific literacy skills were found to be in the "very good" category, as shown in Table 6.

Table 6. Students' Scientific Literacy Skills During Project Implementation

	Context (Science Application)		Content (Science Knowledge)		Competence (Science Process)		Attitude	
Poor	40%	28	16%	11	16%	11	0%	0
Fair	16%	11	31%	22	34%	24	54%	38
Very Good	44%	31	53%	37	50%	35	46%	32

Based on Table 6, it was found that in the aspect of science application, out of 70 students, 31 were categorized as very good, 11 as fairly good, and 28 as less good. In the aspect of scientific knowledge, 37 students were categorized as very good, 22 as fairly good, and 11 as less good. In the aspect of scientific processes, 35 students were categorized as very good, 24 as fairly good, and 11 as less good. In the aspect of attitude, 32 students were categorized as very good and 38 as fairly good.

Scientific literacy is a crucial 21st-century competency that encompasses sensitivity to issues, open-mindedness, the use of scientific knowledge, evidence-based reasoning, and decision-making related to the natural world. It consists of four aspects: competence (scientific processes), content (scientific knowledge), context (application of science), and attitude. The topic Environmental Change and Conservation is highly relevant to daily life and life skills; therefore, the use of a project-based learning model supported by flipbook media is considered appropriate. This model provides authentic experiences, enhances creativity, improves learning outcomes, and strengthens problem-solving skills.

The flipbook is equipped with features such as BioQu, which trains scientific processes through article-based questions; BioVi, which trains science application through video analysis from different perspectives; and BioDi, which develops competence through discussion and idea generation.

During project implementation, students followed these stages: posing essential questions that train scientific knowledge; planning project activities that strengthen science application; scheduling project tasks that develop scientific processes; monitoring project implementation that reinforces scientific knowledge; and evaluating projects that integrate processes, knowledge, and applications of science. This approach facilitated students in identifying problems, designing solutions, and producing outputs, thereby comprehensively improving their scientific literacy.

CONCLUSION

Based on the findings and discussion, the implementation of a project-based learning model supported by flipbook media was effective in improving students' scientific literacy on the topic of Environmental Change and Conservation. This was evidenced by 96% of students achieving N-gain scores in the medium to high category, and statistical analysis showing significant differences between pretest and posttest results. During project implementation, students' scientific literacy reached a fairly good level of understanding, with achievements of 74% in context (science application), 91% in content (scientific knowledge), 70% in competence (scientific process), and 90% in attitude.

REFERENCES

Abidah H.U. (2022). Pengaruh Pembelajaran Model berbasis proyekTerhadap Problem Solving Siswa Kelas X IPA Materi Perubahan Lingkungan Di MAN 1 Jember. *Skripsi*. Jember: UIN KH Achmad Siddiq Jember.

Abidin, Y. (2014). *Desain Sistem Pembelajaran Dalam Konteks Kurikulum*. Bandung: PT Refika Aditama.

Alpusari, M. (2014). Upaya Meningkatkan Aktivitas dan Hasil Belajar Mahasiswa Melalui Penerapan Model Pembelajaran Inkuiri pada Mata Kuliah Konsep Dasar IPA 2 Di Program Studi Pendidikan Guru Sekolah Dasar Tahun Akademik 2013/2014. *Laporan Hasil Penelitian*. Pekanbaru: FKIP Universitas Riau Pekanbaru.

Amirullah. (2015). *Populasi dan Sampel (67) dalam buku Metode Penelitian Manajemen*. Malang: Bayumedia Publishing.

Arikunto. (2006). *Prosedur Penelitian Suatu Pendekatan Praktek*. Jakarta : PT. Rineka Cipta.

Balitbang, Kemendikbud. (2019). *Pendidikan di Indonesia belajar dari hasil PISA 2018*. Jakarta: Pusat Penilaian Pendidikan Balitbang KEMENDIKBUD, No. 021, Hal.20

Bungin, B. (2015). *Analisis data penelitian kuantitatif. Jakarta*: PT Raja Grafindo Persada.

Creswell, J. W. (2009). *Research Design: Qualitative, Quantitative, And Mixed Methods Approaches*. Los Angeles, CA: Sage.

Dimyanti dan Mudjiono. (1999). *Belajar dan Pembelajaran*. Jakarta: Rineka Cipta.

Djafar, D. P. D., & H. A. (2025). Pengaruh Penggunaan Model Problem Based Learning Berbantuan Media Flipbook Terhadap Hasil Belajar Siswa Pada Materi IPAS Di Kelas III SDN 4 Tomilito. *Jurnal Inovasi Pendidikan Matematika dan IPA*, 1024–1033.

Faridah, L. A., Sari, M. S., & Ibrohim, I. (2017). Pengaruh Inkuiri Dan Berbasis Proyekbersumber Potensi Lokal Terhadap Pemahaman Konsep, Keterampilan Proses Sains, Dan Sikap Ilmiah Siswa. *Jurnal Pendidikan Biologi*, *8*(2), 38- 45.

Hapsari D.D, Lisdiana, & Sri Sukaesih. (2016). Pengaruh Pembelajaran Berbasis Proyek Berbantuan Modul Daur Ulang Limbah Pada Literasi Sains. *Journal of Biology Education, 3*, 305–306.

Hendracita, N. (2021). *Model Model Pembelajaran SD.* Bandung: Multikreasi Press.

Indra, W., & Fitria, Y. (2021). Pengembangan Media Games IPA Edukatif Berbantuan Aplikasi Appsgeyser Berbasis Model PBL untuk Mendukung Karakter Peduli Lingkungan Siswa Sekolah Dasar. *JEMS: Jurnal Edukasi Matematika Dan Sains*, 9(1), 59-66.

Istianah, I., & Sy, S. E. (2022). Model Pembelajaran Berbasis Proyek (Project Based Learning): *Penerapan Model Pembelajaran Pada Pelajaran MIPA (Matematika IPA).* Bandung: Media Sains Indonesia.

Jagantara, I. M. W., Adnyana, P. B., & Widiyanti, N. L. P. M. (2014). Pengaruh Model Pembelajaran Berbasis Proyek (Project Based Learning) Terhadap Hasil Belajar Biologi Ditinjau Dari Gaya Belajar Siswa SMA. *Jurnal Pendidikan Biologi*.

Jannah, M. M. H. A., Ismaya, E. A., & Purbasari, I. (2025). Pengaruh Model Pembelajaran Problem Based Learning Berbantuan Media *Flipbook* terhadap Pemahaman Konsep IPAS. *Sulawesi Tenggara Educational Journal, 5 (1),* 101-107.

Khairotun, N. (2019). Pengaruh Model Pembelajaran *Model pembelajaran berbsis proyek*Terhadap Kemampuan Literasi Sains Peserta Didik kelas X Pada Materi jamur. *Skripsi*. Jakarta: Universitas Islam Negeri Syarif Hidayatullah Jakarta.

Mufida, N., & Julianto, T. (2018). Upaya Peningkatan Literasi Sains Siswa Melalui Pembelajaran Berbasis Keunggulan Lokal. *Biosfer: Jurnal Tadris Biologi, 9(1),* 25.

Marjohan, M., & Afniyanti, R. (2018). Penerapan Nilai Pendidikan Karakter Peduli Lingkungan Di Kelas Tinggi Sekolah Dasar. *Jurnal Gentala Pendidikan Dasar*, *3(1)*, 111–126.

Movahedzadeh, F., Patwell R., Rieker J.E., dan Gonzalez T. (2012). Project-Based Learning to Promote Effective Learning in Biotechnology Courses. *Education Research International, Vol. II*, p.1.

Muntari, M., Purwoko, A. A., Savalas, L. R. T., & Wildan, W. (2018). Pembelajaran Berbasis Proyek untuk Meningkatkan Keterampilan Proses Sains dan Berpikir Kritis Siswa. *Jurnal Pendidikan dan Pengabdian Masyarakat*, *1*(1), 120-124.

Nielsen, J. L. (2012). Developing Student Engagement in Network Teaching and Learning Practices Through Problem-and Model pembelajaran berbsis proyekApproaches. *Paper*. Istanbul: International Conference on Communication, Media,Technology and Design ICCMTD.

Nugraheni, D. (2018). Pembelajaran Berbasis Proyek (*Project Based Learning*) Materi Kalor dan Perpindahannya untuk Meningkatkan Kreativitas Siswa. *Jurnal Penelitian Pembelajaran Fisika*, *9(2),* 73-79.

Yuliati, N.H., Hasanah, H., Zulfiati, H.M. (2024). Peningkatan Keaktifan Siswa Melalui Pengembangan Media Pembelajaran Flipbook Pada Mata Pelajaran IPAS berbasis Pembelajaran Berbsis Proyek. *Jurnal Ilmiah Pendidikan Dasar,* 676–687.

Priyatno, D. (2013). *Analisis Korelasi, Regresi, Dan Multivariate Dengan SPSS*. Yogyakarta: Gava Media.

Purwanto. (2013). *Evaluasi Hasil Belajar* . Yogyakarta: Pustaka Pelajar.

Sari, D. N. A., Rusilowati. A., & Nuswowati, M. (2017). Pengaruh Pembelajaran Berbasis Proyek Terhadap Kemampuan Literasi Sains Siswa. *Pancasakti Science Education Journal*, 2, 114.

Saparuddin, S., Kurnia, N., & Thung, C. N. Y. (2022). Pengembangan Panduan Model berbasis proyekBerbasis Riset Pengelolahan Limbah Organik Digunakan Hermetia illucens. *Binomial, 5(2),* 147-160.

Shofiyah, N. (2015). Deskripsi Literasi Sains Awal Mahasiswa Pendidikan IPA Pada Konsep IPA. *Jurnal Pedagogia. 4(12).* 113-120.

Sueni, N. M. (2019). Metode, Model dan Bentuk Model Pembelajaran (Tinjauan Pustaka). *Wacana Saraswati Majalah Ilmiah Tentang Bahasa Sastra Dan Pembelajarannya*, *19*(1), 3-3.

Sugiyono. (2013). *Metode Penelitian Pendidikan Pendekatan Kuantitatif, Kualitatif, dan R&D.* Bandung : Alfabeha.

Surya, A. P., Relmasira, S. C. and Hardini, A. T. A. (2018). Penerapan Model Pembelajaran Model Berbasis Proyekuntuk Meningkatkan Hasil Belajar Dan Kreatifitas Siswa Kelas III SD Negeri Sidorejo Lor 01 Salatiga, *Jurnal Pesona Dasar*, *6(1)*. doi: 10.17529/PEAR.V6I1.10703.

Sustiawati, N. L., & Mudiasih, N. W. (2022). Penciptaan Karya Seni Tari melalui Model Pembelajaran Model Berbasis Proyek Berorientasi Science Technology, Engeenering, Art, and Math (STEAM) sebagai Upaya Menjaga Eksistensi Kearifan Lokal Masyarakat. *Widyadharma: Prosiding Pendidikan Seni Drama, Tari, dan Musik*, *1*(1), 91-100.

Syukriya, A. U. (2019). Implementasi berbasis proyekdengan Media Instagram pada Keterampilan Menulis Bahasa Arab di SMA Islam PB Soedirman 1 Bekasi. *Prosiding Konferensi Nasional Bahasa Arab*, *5*(5), 389-399.

The George Lucas Educational Foundation. (2005). *Instructional Module Project Based Learning*. Diakses dari http://www.edutopia.org/modules/ pbl/project-based-learning. Diakses pada 24 Oktober 2022.

Toharudin, U., Hendrawati, S., Rustaman, Andrian. (2011). *Membangun Literasi Sains Siswa*. Bandung; Humaniora.

Uno, H. B. (2021). *Teori motivasi dan pengukurannya: Analisis di bidang pendidikan*. Jakarta: Bumi Aksara.

Wafula, W. N., & Odhiambo, O. R. (2016). Model Pembelajaran Berbasis Proyekon Students' Performance In The Concept Of Classification Of Organisms Among Secondary Schools In Kenya. *Journal of Education and Practice, 7*, 28–34.

Winarni, E. W. (2013). Perbandingan Sikap Peduli Lingkungan, Keterampilan Proses, dan Pemahaman Konsep Antara Siswa pada Pembelajaran IPA Menggunakan Pendekatan Jelajah Alam Sekitar (JAS) dan Ekspositori di Sekolah Dasar. *Jurnal Ilmiah PGSD FIP UNJ*, 5(1), 145–153.

Yulianti. (2017). Analisis Nilainilai Pendidikan Karakter dalam Buku Teks Kelas VII SMP/MTs: *Kajian Semiotika Charles Sandres Peirce.* Makassar: Universitas Negeri Makassar.