Widyagogik: Jurnal pendidikan dan Pembelajaran Sekolah Dasar
Journal homepage: https://journal.trunojoyo.ac.id/widyagogik ; ISSN: 2541-5468

THE IMPLEMENTATION OF SCRATCH-ASSISTED GAME-BASED LEARNING TO IMPROVE ELEMENTARY SCHOOL STUDENTS' ANALOGICAL REASONING SKILLS ON BIOTIC AND ABIOTIC TOPICS

Alifa Rahma Aulia[1*], Naila Rahmadani Ridwan[2], Suci Rohmawati[3], Neni Hermita[4], Rifqa Gusmida Syahrun Barokah[5]
[1,2,3,4,] Universitas Riau, Riau, Indonesia
*) Corresponding Author: email: alifa.rahma0487@student.unri.ac.id

ABSTRACT
This study aims to examine the effect of using game-based learning media, assisted by Scratch, on improving students' analogical reasoning skills in learning biotic and abiotic concepts in the third grade of elementary school. Previous studies have generally focused on the use of Scratch to enhance programming or computational thinking skills; therefore, research that specifically investigates its effect on analogical reasoning skills in elementary science learning remains limited. This study employed a quantitative, quasi-experimental method using a one-group pretest–posttest design. The research subjects consisted of 25 third-grade students at SDN 130 Pekanbaru. Data were collected through validated, reliable essay-based tests. The research procedure included administering a pretest, implementing game-based learning using Scratch, and conducting a posttest.
The results showed an improvement in students' mean scores from 50.83 in the pretest to 67.50 in the posttest. The N-Gain score of 0.31 falls into the moderate category, indicating an improvement in students' analogical reasoning skills after the learning intervention. In addition, the decrease in standard deviation from 22.25 to 18.24 suggests a more even distribution of students' understanding. In conclusion, the implementation of Scratch-assisted game-based learning demonstrates a positive contribution to improving students' analogical reasoning skills in learning biotic and abiotic concepts at the elementary school level.

Keywords: Game-Based Learning, Scratch, Analogical Reasoning, Biotic and Abiotic Concepts, Elementary School.

Article History:
Received: 05 May 2026; Revised: 14 October 2026; Accepted: 14 October 2026; Published: 21 October 2026

Citation (in APA style 7):
Aulia, A.R., Ridwan, N.R., Rohmawati, S., Hermita, N., & Barokah, R.G.S. (2026). The implementation of scratch-assisted game-based learning to improve elementary school students' analogical reasoning skills on biotic and abiotic topics. *Widyagogik, 14*(1), 35–42. https://doi.org/10.21107/widyagogik.v14i2.34311

INTRODUCTION

At the elementary school level, science learning, particularly on the topic of biotic and abiotic components, is often presented as a rigid memorization of classifications

between living and non-living things. However, the essence of this topic lies not merely in classification but in understanding the functional interactions among components within an ecosystem. This understanding requires higher-order cognitive processes, one of which is *analogical reasoning*. In practice, students frequently encounter difficulties because the material is perceived as abstract and disconnected from their daily experiences, which may lead to misconceptions, such as incorrectly categorizing objects derived from living organisms (e.g., dried wood) as purely abiotic (Icela, 2022; Thornhill-Miller et al., 2025).

The development of analogical reasoning skills is essential, as it enables students to connect new concepts with their prior knowledge. According to Silvatama et al. (2024), analogical reasoning facilitates understanding through comparison and association between concepts. In science learning, particularly in conceptual topics such as biotic and abiotic components, this ability plays a significant role in helping students comprehend the relationships between living organisms and their environment (Lv et al., 2022). Thus, students are not limited to memorizing concepts but are encouraged to construct meaningful and integrated understanding through relevant learning experiences (Irawati & Hadi, 2025; Utami & Ghufron, 2024).

However, students' analogical reasoning skills at the elementary level remain underdeveloped. This issue is influenced by several factors, including less varied instructional methods, the abstract nature of the material, and the limited concrete experiences available to students (Eriksson et al., 2026). Therefore, innovative learning approaches are needed to bridge the gap between abstract concepts and students' real-life experiences.

With the advancement of technology, the use of digital learning media has emerged as a promising alternative. One such medium is Scratch, a visual programming platform designed to support creative and interactive learning. Through Scratch, students can create simple animations and simulations that represent biotic and abiotic concepts. This activity allows students to actively engage in the learning process, enabling them not only to receive information passively but also to construct their understanding through direct exploration (Triambodo et al., 2022).

The integration of Scratch into science learning provides opportunities for students to develop higher-order thinking skills, including analogical reasoning. Its engaging and interactive visual features help students observe, compare, and relate various concepts more effectively. Previous studies have shown that technology-based learning media can enhance student engagement and deepen conceptual understanding (Anisa et al., 2024). Furthermore, interactive learning environments have been proven to support the development of critical and analytical thinking skills.

Nevertheless, research on the use of Scratch in elementary science education, particularly in relation to biotic and abiotic topics and their connection to analogical reasoning skills, remains limited. Most previous studies have focused on improving

CC BY SA

programming or computational thinking skills, leaving the aspect of analogical reasoning relatively underexplored.

Based on the above considerations, this study aims to examine the effect of Scratch-based learning media on the improvement of third-grade elementary school students' analogical reasoning skills in learning biotic and abiotic concepts. The findings of this study are expected to contribute to the development of innovative, interactive, and student-centered learning media that align with the needs of learners in the digital era. Additionally, this research is expected to serve as a reference for educators in designing instructional practices that not only focus on content mastery but also foster higher-order thinking skills in a meaningful way.

METHOD

This study employed a quantitative, quasi-experimental research design. Specifically, a one-group pretest–posttest design was implemented, in which a single group of students was assessed before and after the intervention. Pretest and posttest instruments were administered individually to measure changes in students' learning outcomes following the treatment.

The study was conducted in April of the 2025/2026 academic year at an elementary school in Tuah Madani District, Pekanbaru City. The population involved third-grade students from SDN 130 Pekanbaru, with a total sample of 25 students selected as the research subjects. The instructional intervention utilized a discovery learning model supported by Scratch-based learning media.

Data were collected through a test consisting of seven open-ended (essay) questions. The instrument was developed based on indicators of analogical reasoning skills and had previously undergone validity and reliability testing to ensure its appropriateness.

The indicators used to measure students' analogical reasoning skills in this study included:

1. Identifying similarities between two different situations or concepts.
2. Determining correct analogical pairs by identifying equivalent relationships.
3. Applying analogical relationships to solve new problems based on prior knowledge or experience.
4. Explaining the reasoning behind analogical relationships in a logical and structured manner.

The data collection procedure consisted of three stages. First, students were given a pretest to assess their prior knowledge. Second, the learning process was conducted using a game-based learning approach supported by Scratch media. Third, students completed a posttest to measure improvements in their learning outcomes (Azzahra et al., 2025).

CC BY SA

FINDINGS

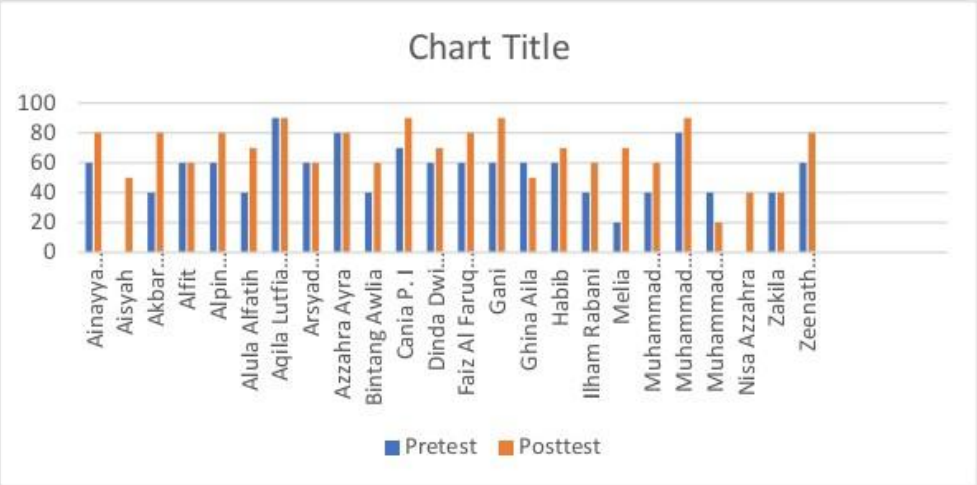
The evaluation of students' analogical reasoning skills was conducted through an analysis of pretest and posttest data. The assessment instrument consisted of a combination of objective and open-ended questions specifically designed to measure the indicators of analogical reasoning.

The participants of this study were 25 students from class 3-C of SDN 130 Pekanbaru in the 2025/2026 academic year. This research focused on a single experimental group without a control group for comparison, following a one-group pretest–posttest design.

The results of the pretest and posttest scores are presented in Table 1.

Table 1. Average Pretest and Posttest Scores for Analogical Reasoning Ability

Mean		
Description	**Pre Test**	**50,83**
	Post Test	**67,50**



The research findings indicate a positive trend in students' learning achievement. The mean pretest score of 50.83 increased significantly to 67.50 in the posttest following the implementation of Scratch-based learning media. This improvement suggests that technology-based instructional interventions are effective in facilitating a deeper understanding of biotic and abiotic concepts compared to conventional teaching methods.

Furthermore, the findings demonstrate an enhancement in students' conceptual understanding of biotic and abiotic components through the use of Scratch. Therefore, the use of Scratch can be considered a valid and effective approach to improving students' analogical reasoning skills in learning these concepts.

CC BY SA

Variabel	Value	Category
Average Pretest Score	50,83	Low
Average Posttest Score	67,50	Moderate
Pretest Standard Deviation	22,25	-
Posttest Standard Deviation	18,24	-
Average N-Gain	0.31	Moderate

Further analysis using the N-Gain test yielded a score of 0.31, which falls into the moderate category, indicating that the improvement, while evident, has not yet reached an optimal level. In addition, the standard deviation in the pretest (22.25) was higher than in the posttest (18.24). This finding suggests that students' abilities were more varied before the learning intervention. After the instructional process, the variation in scores decreased, indicating that students' understanding became more consistent and evenly distributed.

The effectiveness of the learning intervention is also reflected in the N-Gain score of 0.31, categorized as moderate. This result indicates a reasonably effective improvement in students' learning outcomes, although there is still room for enhancement to achieve a higher level of effectiveness. Therefore, the implemented instructional strategy has been successful in improving learning outcomes, but further refinement is needed to maximize its impact.

Overall, these findings are consistent with constructivist learning theory, which posits that active student engagement in the learning process leads to deeper conceptual understanding (Nugraha & Herdiana, 2024). This highlights the importance of educators to continuously develop innovative and interactive teaching strategies to achieve better learning outcomes.

DISCUSSION

This study is also supported by previous research. Henderson (2022), as cited in Çakıroğlu and Muştuoğlu (2025), emphasizes mathematical generalization skills, which are closely related to analogical reasoning. Generalization involves deriving general rules or patterns from specific examples, a process that fundamentally requires the ability to connect different situations based on similarities in structure or relationships (Refianti, 2022; Susanto et al., 2025). The study further explains that mathematical thinking is a dynamic process involving problem understanding, strategy formulation, and systematic problem-solving. These processes include comparing, organizing, and verifying—key components of analogical reasoning (Refianti, 2022).

Moreover, the effectiveness of Scratch in enhancing analogical reasoning skills can be attributed to its visual, interactive, and exploratory characteristics. Scratch enables students to observe relationships between concepts concretely through animations and simulations, thereby facilitating the identification of similarities in patterns or structures (analogical visualization). Its interactive features encourage students to experiment,

modify, and test ideas directly, supporting processes such as comparison and verification. This exploratory learning process allows students not only to receive information but also to construct their own understanding by linking prior knowledge to new situations. This is in line with findings by Hermita et al. (2024), which indicate that visual programming-based learning can enhance higher-order thinking skills through active engagement in problem-solving and pattern recognition.

Compared to conventional learning media, the use of Scratch within a game-based learning approach offers distinct advantages, as it integrates elements of play and learning simultaneously. For instance, Wicaksana and Apriyanto (2025) found that students who learned using interactive game-based media demonstrated better concept transfer abilities than those taught using traditional lecture methods. This suggests that Scratch not only improves learning outcomes quantitatively but also enhances the quality of students' thinking processes, particularly in connecting different concepts through analogical reasoning.

Additionally, learning media play a crucial role as tools for delivering information and facilitating interaction between teachers and students (Pradja & Saputra, 2023). In the context of this study, the use of Scratch-based game-based learning has been shown to provide a more targeted improvement in students' analogical reasoning skills, rather than merely increasing test scores. This is evidenced by the increase in the average score from 50.83 in the pretest to 67.50 in the posttest, indicating a meaningful improvement in students' ability to understand and relate concepts.

Based on the above discussion, it can be concluded that this study is consistent with previous research highlighting the effectiveness of Scratch-based game-based learning in enhancing students' analogical reasoning skills. The observed improvement in learning outcomes is not solely attributed to the instructional intervention but also to the inherent characteristics of Scratch, which support analogical thinking through visualization, interaction, and exploration. Therefore, Scratch can be considered an effective alternative learning medium for fostering higher-order thinking skills among elementary school students.

CONCLUSION

Based on the research conducted at SDN 130 Pekanbaru, it can be concluded that the implementation of the Game-Based Learning (GBL) method has the potential to enhance students' understanding of biotic and abiotic concepts in class 3-C. The analysis of pretest and posttest data indicates a noticeable improvement in students' conceptual understanding after participating in learning activities supported by game-based media such as Scratch. The application of GBL successfully transforms biotic and abiotic concepts, which were initially abstract and difficult for students to grasp, into engaging and meaningful learning experiences.

CC BY SA

Furthermore, the implementation of GBL contributes to the improvement of students' analogical reasoning skills. This is evidenced by students' ability to complete Scratch-based learning activities related to biotic and abiotic topics. The improvement in students' understanding confirms that GBL can serve as an effective approach to bridging the gap between theoretical concepts and practical learning experiences in elementary science education.

In addition, the effectiveness of Scratch in enhancing analogical reasoning skills is closely related to its visual, interactive, and exploratory characteristics. These features enable students to actively engage in the learning process, facilitating deeper conceptual understanding and supporting higher-order thinking skills.

For future research, it is recommended to explore various types of game-based learning models and examine their impact on other cognitive aspects, such as creativity and learning motivation. Such investigations may provide broader insights into the role of interactive digital media in improving the overall quality of elementary education.

REFERENCES

Anisa, N., Winarsih, S., Rohman, M. S., & Saraswati, G. W. (2024). Penalaran logika menggunakan Scratch pada SD Negeri Pendrikan Lor 03. *ABDIMASKU: Jurnal Pengabdian Masyarakat, 7*(2), 684–689. https://doi.org/10.62411/ja.v7i2.2258

Azzahra, S., Sujana, A., & Sunaengsih, C. (2025). Pengaruh media berbasis Scratch pada materi cuaca dalam meningkatkan kemampuan berpikir kritis siswa kelas 3 sekolah dasar. *J-KIP (Jurnal Keguruan dan Ilmu Pendidikan), 6*(3), 995–1001. https://doi.org/10.25157/j-kip.v6i3.17653

Çakıroğlu, Ü., & Muştuoğlu, E. (2025). Mathematical thinking behind coding: Promoting generalization skills via Scratch. *International Journal of Science and Mathematics Education, 23*(7), 2375–2396. https://doi.org/10.1007/s10763-025-10556-9

Eriksson, S., Gericke, N., & Thörne, K. (2026). Analogy competence for science teachers. *Studies in Science Education, 62*(1), 41–69. https://doi.org/10.1080/03057267.2024.2434797

Hermita, N., Alim, J. A., Teguh, A., & Almais, W. (2024). Developing programming learning media using Scratch on the concept of buoyancy to improve computational thinking in primary school. *Journal of Natural Science and Integration, 7*(2), 274–291. https://doi.org/10.24014/jnsi.v7i2.32554

González-Pérez, L. I., & Ramírez-Montoya, M. S. (2022). Components of Education 4.0 in 21st century skills frameworks: Systematic review. *Sustainability, 14*(3), Article 1493. https://doi.org/10.3390/su14031493

Irawati, L., & Hadi, M. S. (2025). Computataional thinking dalam pengembangan berpikir matematis di sekolah dasar. *JIIP: Jurnal Ilmiah Ilmu Pendidikan, 8*(2), 2358–2364. https://doi.org/10.54371/jiip.v8i2.7106

Lv, X., Li, L., Guo, L., He, T., & Liu, S. (2022). Game-based formative assessment of analogical reasoning in preschool children: *Support from the Internet of Things Technology. Sustainability, 14*(21), Article 13830. https://doi.org/10.3390/su142113830

Nugraha, W., & Herdiana, D. (2024). Teori belajar konstruktivisme dan implikasinya dalam pembelajaran. *Journal of Education, 1*(1), 270–277. https://doi.org/10.65353/7ccg8x35

Pradja, B. P., & Saputra, N. N. (2023). Usage of Scratch in making game-based mathematics learning media to improve students' mathematical skills. *Prima: Jurnal Pendidikan Matematika, 7*(2), 131–142. https://doi.org/10.31000/prima.v7i2.8613

Refianti, R. (2022). Kemampuan generalisasi matematis melalui pendekatan keterampilan metakognitif di SMP Negeri Megang Sakti. *Jurnal Perspektif Pendidikan, 16*(1), 44–51. https://doi.org/10.31540/jpp.v16i1.1569

Silvatama, M. A., Alvarez, J. I., & Murtafiah, W. (2024). Analogical reasoning of sensing and intuition personality student in solving proportion problem: Two-variable into three-variable direct proportion word problem. *Kreano, Jurnal Matematika KreatifInovatif, 15*(2), 423–437. https://doi.org/10.15294/tey38g29

Susanto, R. A., Mutiah, M. I., Hanif, A., & Saksitha, D. A. (2025). Pengertian dan macammacam generalisasi (Studi kasus: Generalisasi). *Al-Mizan, 1*(2), 60–70.

Thornhill-Miller, B., Camarda, A., Mercier, M., Burkhardt, J.-M., Morisseau, T., BourgeoisBougrine, S., Vinchon, F., El Hayek, S., Augereau-Landais, M., Mourey, F., Feybesse, C., Sundquist, D., & Lubart, T. (2023). Creativity, critical thinking, communication, and collaboration: Assessment, certification, and promotion of 21st century skills for the future of work and education. *Journal of Intelligence, 11*(3). https://doi.org/10.3390/jintelligence11030054

Triambodo, Y., Putro, M., & Astuti, R. (2022). Penerapan Scratch dalam pembelajaran coding siswa sekolah dasar. *Emergent: Journal of Educational Discoveries and Lifelong Learning (EJEDL), 1*(4), 1–21. https://doi.org/10.47134/emergent.v1i4.37

Utami, S., & Ghufron, A. (2024). A critical appraisal: Elementary school coding education effectiveness with Scratch in alignment with cognitive development, analyzed through Piagetian lens. *Journal of Electrical Systems, 20*(5), 1180–1187. https://doi.org/10.52783/jes.2432

Wicaksana, B. S., & Apriyanto, A. (2025). Improving reasoning skills in primary school students: An experimental study on 2D game development with Scratch. *IELTech: Informatics Education and Learning Technologies, 1*(1), 20–30. https://doi.org/10.23917/ieltech.16524