EFFECTIVENESS OF MONOPOLY MEDIA TO IMPROVE STUDENTS' CONCEPTUAL UNDERSTANDING OF THE EXCRETORY SYSTEM MATERIAL

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ABSTRACT

Critical thinking skills are one of the abilities emphasized in learning. However, critical thinking skills in biology learning at several schools in Indonesia hasn't yet been optimal. One contributing factors is the lack of conceptual understanding as a foundation for developing critical thinking skills. This issue is particularly evident in the excretory system topic, which is considered difficult due to its numerous scientific terminologies and complex physiological processes. This study aimed to determine the effectiveness of Monopoly game as a learning medium in improving the conceptual understanding of 11th-grade high school students in excretory system material. This study uses the Research and Development (R&D) approach using the ADDIE development model. A limited trial was conducted on 14 11th-grade students at SMA Negeri 1 Waru. The effectiveness test was determined by comparing students' pre-test and post-test scores using the N-gain analysis and calculation of conceptual understanding indicators achievement. The results showed that the effectiveness test yielded an average N-gain score of 0.49, which falls into the moderate category and the indicators achievement get percentage of 79% with the category achieved, indicating that the learning media was effective in improving students' conceptual understanding of the excretory system materials. The improvement was supported by the characteristics of the Monopoly game, which is played collaboratively in groups, encouraging students to actively participate in learning through interaction, information sharing, discussion, and connecting various biological concepts to solve problems. Therefore, the excretory system Monopoly game is considered feasible as an alternative learning medium for enhancing students' conceptual understanding.

Keywords: *ADDIE model, media effectiveness, quality education.*

ABSTRAK

Kemampuan berpikir kritis merupakan salah satu keterampilan yang ditekankan dalam pembelajaran. Namun, keterampilan berpikir kritis pada materi biologi di beberapa sekolah di Indonesia belum berjalan secara optimal. Salah satu faktornya adalah kurangnya pemahaman konsep sebagai pondasi yang harus dimiliki oleh peserta didik sebelum mengembangkan keterampilan berpikir kritis. Terutama pada materi sistem ekskresi yang masih dianggap sulit untuk dipahami karena memuat banyak terminologi dan proses fisiologis yang kompleks. Penelitian ini bertujuan untuk mengetahui efektivitas media monopoli sistem ekskresi dalam meningkatkan pemahaman konsep peserta didik kelas XI SMA. Penelitian ini menggunakan

metode *Research and Development* (R&D) dengan model pengembangan ADDIE. Uji coba terbatas dilakukan terhadap 14 peserta didik kelas XI SMA Negeri 1 Waru. Efektivitas media ditinjau dari hasil *pre-tes* dan *post-test* menggunakan analisis *N-gain* dan perhitungan ketercapaian indikator. Hasil penelitian menunjukkan bahwa uji efektivitas media monopoli sistem ekskresi memperoleh nilai rata-rata *N-gain* sebesar 0,49 yang termasuk dalam kategori sedang, dan ketercapaian indikator dengan persentase sebesar 79% dengan kategori tercapai, sehingga media monopoli dapat dinyatakan efektif untuk meningkatkan pemahaman konsep peserta didik pada materi sistem ekskresi. Peningkatan tersebut oleh karakteristik permainan monopoli yang dimainkan secara berkelompok, sehingga mendorong peserta didik untuk aktif dalam pembelajaran dengan berinteraksi, bertukar informasi, berdiskusi, dan menghubungkan berbagai konsep materi untuk menyelesaikan soal. Dengan demikian, media monopoli sistem ekskresi dinyatakan layak untuk digunakan sebagai media alternatif untuk meningkatkan pemahaman konsep peserta didik.

Kata Kunci: model ADDIE, efektivitas media, pendidikan berkualitas

A. Introduction

The demands of 21st-century education require students to develop critical thinking skills (Cahyaningsih et al., 2025). In line with these demands, the Merdeka Curriculum was designed to encourage students to actively participate in the learning process (Kurnia & Aprison, 2024). Nevertheless, several studies conducted in various regions of Indonesia have reported that students' critical thinking skills remain at low to moderate levels (Sugiharti & Gayatri, 2020; Hulu et al., 2024; Azrai et al., 2020; Ekasari et al., 2024).

One of the factors contributing to students' low critical thinking skills is their inadequate conceptual understanding. Conceptual understanding serves as the foundation for developing critical thinking skills (Hanipah, 2023). It involves not only the ability to recall information but also the ability to connect different concepts in order to explain biological phenomena (Zaitsev, 2021).

In biology learning, conceptual understanding is essential because students are required not only to learn scientific facts and concepts but also to comprehend abstract and complex biological processes as well as the relationships among those concepts. The excretory system is one of the topics taught in Grade XI of senior high school. The large number of scientific terms and physiological processes involved remains a challenge for students in understanding this topic (Simorangkir & Napitupulu, 2020). The

excretory system encompasses the interrelationships among organs and physiological mechanisms, including urine formation and body fluid regulation, which are essential for maintaining homeostasis. Such complexity requires students to go beyond rote memorization and develop an understanding of the relationships among concepts in order to explain the mechanisms of the excretory system comprehensively (Ridwan et al., 2024).

The results of a questionnaire administered to Grade XI students at SMA Negeri 1 Waru indicated that many students experienced difficulties in learning the excretory system, particularly topics related to anatomical structures and physiological processes. Classroom observations also revealed that teachers primarily relied on lecture-based instruction supported by text-dominated PowerPoint presentations. Previous studies have suggested that this instructional approach is less effective in facilitating students' conceptual understanding (Zhang et al., 2022; Harita, 2024).

Based on these findings, learning media that facilitate students' conceptual understanding are needed. Learning media play an important role in supporting learning activities that help students construct and strengthen conceptual understanding (Cahyadi, 2019). Learning motivation is one of the factors influencing conceptual understanding. Shidik (2020) reported a positive correlation between students' learning motivation and their level of conceptual understanding. One type of learning media considered suitable for achieving this objective is game-based learning. Learning through games tends to actively engage students physically, socially, and cognitively.

One form of game-based learning that meets these requirements is Monopoly. Monopoly is played collaboratively in groups, encouraging interaction among players, teamwork, and discussion while creating an enjoyable learning atmosphere (Dewi et al., 2021). The characteristics of Monopoly make it suitable as a learning medium for the excretory system because it requires students to analyze information, engage in discussions based on relevant evidence, and make decisions. In addition, Monopoly promotes collaborative inquiry, enabling

students to construct knowledge through interaction with their peers (Othman et al., 2025).

Several previous studies, including those by Mayana (2022) on cell structure, Miranti et al. (2021) on the organization of life, and Salmawati et al. (2019) on the nervous system, reported that nearly all students achieved learning mastery after using Monopoly-based learning media. These findings indicate that Monopoly is both feasible and effective for biology instruction. However, studies investigating the effectiveness of Monopoly-based learning media in improving students' conceptual understanding of the excretory system remain limited. Furthermore, the excretory system has distinctive characteristics because it involves complex relationships among concepts and physiological processes, requiring appropriate instructional strategies. Therefore, this study aims to determine the effectiveness of Monopoly-based learning media in improving Grade XI senior high school students' conceptual understanding of the excretory system. The findings of this study are expected to provide insights into the use of Monopoly-based learning media as an alternative approach to enhancing students' conceptual understanding.

B. Research Method

This study employed a Research and Development (R&D) approach using the ADDIE development model, which consists of five stages: analysis, design, development, implementation, and evaluation. However, this article focuses only on discussing the effectiveness of the developed excretory system Monopoly learning media.

The study was conducted at the Undergraduate Biology Education Program, Faculty of Mathematics and Natural Sciences, Universitas Negeri Surabaya, and SMA Negeri 1 Waru. A limited trial was carried out involving 14 eleventh-grade senior high school students as the research participants. Prior to the implementation, interviews, classroom observations, and student questionnaires were conducted to identify learning problems. Curriculum and content analyses were then performed as the basis for developing the test instruments used to assess students' conceptual understanding.

The research instruments consisted of a media validation sheet and achievement tests (pre-test and post-test) developed based on the conceptual understanding indicators adapted from the revised Bloom's Taxonomy, namely: defining concepts, classifying concepts, providing examples and non-examples, identifying relationships among elements, applying principles to explain processes, and drawing conclusions about the impacts of events based on concepts (Krathwohl, 2002). The pre-test was administered to measure students' initial conceptual understanding of the excretory system, whereas the post-test was used to assess their conceptual understanding after learning with the excretory system Monopoly media.

The effectiveness of the learning media was determined by analyzing the improvement in students' learning outcomes as an indicator of conceptual understanding using the normalized gain (N-gain) formula, as follows.

$$N\text{-}gain = \frac{Sf - Si}{Smax - Si}$$

Keterangan:

Sf : *post-test* score

Si : *pre-test* score

Smax : maximum score

Table 1. Gain score criteria (Hake, 1998).

Gain score	Category
0,00 < *gain score* ≤ 0,30	Low
0,30 < *gain score* ≤ 0,70	Moderate
0,70 < *gain score* ≤ 1,00	High

Based on the criteria presented in Table 1, the excretory system Monopoly media was considered effective in improving students' conceptual understanding if it achieved an N-gain score greater than 0.30 (Devega et al., 2022). In addition to the N-gain analysis, the effectiveness of the media was also evaluated based on the achievement of conceptual understanding indicators. The percentage of indicator achievement was calculated using the following formula:

Indicator Achievement Percentage

$$(\%) = \frac{\sum obtained\ score}{\sum maximum\ score}$$

Table 2. Criteria for Indicator Achievement Scores (Riduwan, 2016).

Percentage (%)	Category
25-40	Not Achieved
41-55	Poor
56-70	Fair
71-85	Achieved
86-100	Highly Achieved

Based on the criteria presented in Table 2, the conceptual understanding indicators were considered achieved if they obtained an achievement percentage of at least 71%.

C. Result and Discussion

The effectiveness test was conducted to determine the effectiveness of the learning media in improving students' conceptual understanding. In this study, effectiveness was measured using pre-test and post-test instruments and analyzed through the N-gain formula and the calculation of conceptual understanding indicator achievement. The N-gain analysis was used to determine the improvement in students' conceptual understanding based on their learning outcomes after the implementation of the excretory system Monopoly learning media. The comparison of students' pre-test and post-test scores is presented in the following figure.

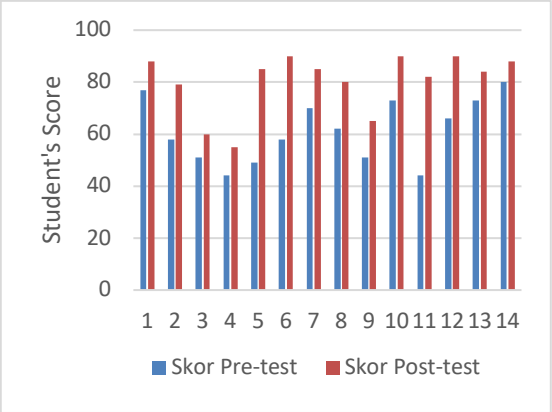

Figure 1. Comparison of Students' Pre-test and Post-test Scores

As shown in Figure 1, all students demonstrated an increase in their post-test scores compared to their pre-test scores. These scores were subsequently analyzed using the N-gain formula to determine the improvement in students' conceptual understanding of the excretory system topic. The detailed results of the N-gain analysis are presented in Table 3.

Table 3. N-gain analysis result

No	*Pre-Test*	*Post-Test*	*Gain Score*
1	77	88	0,47
2	58	79	0,50
3	51	60	0,18
4	44	55	0,19
5	49	85	0,70
6	58	90	0,76
7	70	85	0,50
8	62	80	0,47
9	51	65	0,28
10	73	90	0,62
11	44	82	0,67
12	66	90	0,70
13	73	84	0,41
14	80	88	0,40
Mean			**0,49**

Based on Table 3, it can be seen that the average N-gain score was 0.49, which indicates a moderate category. This result shows a moderate improvement in students' conceptual understanding of the excretory system material based on learning outcomes. According to Devega et al. (2022), the developed media can be considered effective if it obtains a gain score > 0.30. Although the improvement is still within the moderate category, these results indicate that the excretory system monopoly media was able to provide a positive impact on students' conceptual understanding of the excretory system material after being implemented once in the learning process.

One of the factors influencing the improvement in conceptual understanding is the characteristic of the monopoly game, which is played in groups. During the game session, students actively searched for information, connected concepts related to the material, and discussed with group members to solve the questions. This condition is in accordance with Vygotsky's constructivism theory, which states that knowledge is constructed through learning experiences and interactions with peers (Harefa et al., 2024).

Although the media was considered effective based on the N-gain calculation results, the improvement in conceptual understanding was still in the moderate category. The post-test results showed that there were still 3 students who had not achieved learning mastery. Based on observations during the implementation, students who had not achieved mastery tended to be less focused and less actively involved in discussions during the game session compared to other students. Good student engagement and concentration during learning have a

positive impact on improving learning outcomes (Meri et al., 2023; Yuliana et al., 2021). This indicates that student involvement and concentration affect the improvement of conceptual understanding during the learning process.

In addition to the N-gain analysis, the effectiveness of the media was also reviewed based on the achievement of conceptual understanding indicators. The calculation data of indicator achievement can be seen in the following table:

Table 4. Results of conceptual understanding indicator achievement calculation

No	Conceptual Understanding Indicators	*Pre* (%)	*Post* (%)
1.	Defining concepts	100	92,8
2.	Classifying concepts	75	79,4
3.	Giving examples and non-examples	42,8	78,5
4.	Understanding the relationships between elements	56,1	75
5.	Using principles to explain a process	61,3	72,4
6.	Drawing conclusions about the impact of an event based on concepts	56	76,2
	Mean	**65,1**	**79**

Based on Table 4, it is known that the average achievement of the six conceptual understanding indicators in the pre-test obtained a percentage of 65.1%, which was categorized as sufficient, while the average achievement in the post-test obtained a percentage of 79%, which was categorized as achieved. These results indicate that the implementation of the excretory system monopoly media was able to assist in improving the overall achievement of students' conceptual understanding indicators.

Although there was an improvement in all indicators, the fourth, fifth, and sixth indicators, which required the ability to connect and apply concepts, obtained lower percentages compared to the other indicators. This was caused by several groups that had not completed the game up to level 3 due to limited learning time, resulting in some students not having the opportunity to work on questions designed to train their ability to connect and apply concepts. According to Ausubel's meaningful learning theory, understanding is formed when students are able to relate new

knowledge to previously acquired knowledge (Harefa et al., 2024). Therefore, the limitation of students' opportunities to work on questions requiring connections between concepts became one of the factors affecting the improvement of conceptual understanding.

D. Conclusion

Based on the research that has been conducted, the excretory system monopoly media was considered effective in improving students' conceptual understanding of the excretory system material. The effectiveness was assessed based on the N-gain analysis, which obtained a score of 0.49 and was categorized as moderate. This result was also supported by the analysis of conceptual understanding indicator achievement, which obtained an average percentage of 79% with an achieved category. Therefore, the monopoly media can be used as an alternative learning medium to improve students' conceptual understanding of the excretory system material. For future research, teachers are advised to condition the learning environment and consider time allocation so that the implementation of monopoly media can be carried out optimally. Furthermore, the monopoly media can be implemented with a broader subject scope and a longer duration so that its effectiveness can be evaluated more comprehensively.

REFERENCES

Azrai, E. P., Suryanda, A., Wulaningsih, R. D., & Sumiyati, U. K. (2020). Kemampuan berpikir kritis dan literasi sains siswa SMA di Jakarta Timur. *EDUSAINS, 12*(1), 89–97.

Cahyadi, A. (2019). *Pengembangan media dan sumber belajar: Teori dan prosedur*. Serang, Indonesia: Penerbit Laksita Indonesia.

Cahyaningsih, A., Aulia, H., Ramadhani, L., Alwi, N. A., & Yarisdaningsih. (2025). Transformasi kurikulum dalam menghadapi tantangan pendidikan abad 21. *Jurnal Nakula: Pusat Ilmu Pendidikan, Bahasa dan Ilmu Sosial, 3*(3), 352–367.

Devega, T. T., Ambiyar, P., Novi, H. A., & Riyanda, A. R. (2022). Efektivitas media pembelajaran terhadap hasil belajar komputer dan jaringan dasar siswa vokasi. *Jurnal Pendidikan Teknologi Kejuruan, 5*(2), 47–52.

Dewi, A. A., Tegeh, I. M., & Ujianti, P. R. (2021). Media pembelajaran monopoli berbasis karakter pada anak usia dini. *Jurnal*

Media dan Teknologi Pendidikan, 1(2), 77–84.

Ekasari, Y. C., Nikmah, A., Rizkiyah, R. F., Rachmawati, R. N., & Sansena, M. A. (2024). Analisis keterampilan berpikir kritis dalam pembelajaran biologi materi sistem reproduksi manusia pada siswa SMA Putra Bangsa Kabupaten Tangerang. *JKPI: Jurnal Kajian Pendidikan IPA, 4*(2), 384–388.

Hake, R. R. (1998). I*nteractive-engagement versus traditional methods: A six-thousand-student survey of mechanics test data for introductory physics courses. American Journal of Physics, 66*(1), 64–74.

Hanipah, S. (2023). Analisis kurikulum Merdeka Belajar dalam memfasilitasi pembelajaran abad ke-21 pada siswa menengah atas. *Jurnal Bintang Pendidikan Indonesia (JUBPI), 1*(2), 264–275.

Harefa, E., Afendi, A. R., Karuru, P., Sulaeman, & Wote, A. Y. V. (2024). *Buku ajar teori belajar dan pembelajaran*. Jambi, Indonesia: PT Sonpedia Publishing Indonesia.

Harita, K. B. (2024). Analisis kesulitan belajar siswa dalam pembelajaran biologi pada kelas X SMA Negeri 1 Gomo. *Jurnal Pendidikan Biologi, 5*(2), 103–121.

Hulu, T. D., Zega, N. A., Gulo, H., & Harefa, A. R. (2024). Analisis kemampuan berpikir kritis siswa dalam konteks pembelajaran biologi SMA Negeri 1 Lahewa Timur. *Learning: Jurnal Inovasi Penelitian Pendidikan dan Pembelajaran, 4*(3), 805–812.

Krathwohl, D. R. (2002). *A revision of Bloom's taxonomy: An overview. Theory Into Practice, 41*(4), 212–218.

Kurnia, T., & Aprison, W. (2024). Implementasi Kurikulum Merdeka sebagai upaya meningkatkan keterampilan abad 21. *Jurnal Lingkar Pembelajaran Inovatif, 5*(5), 42–47.

Mayana, N. (2022). *Pengembangan media monopoli pada materi struktur sel di SMA Negeri 1 Panga Aceh Jaya* (Skripsi). Universitas Islam Negeri Ar-Raniry, Banda Aceh, Indonesia.

Meri, Maria, H. T., & Karolina, V. (2023). Korelasi antara tingkat keaktifan peserta didik dengan hasil belajar melalui model pembelajaran *discovery learning. Jurnal Dimensi Pendidikan dan Pembelajaran, 11*(1), 206–211.

Mirantia, R. S., & Amnah, T. I. S. (2021). Pengembangan media pembelajaran biologi berupa permainan monopoli pada materi organisasi kehidupan untuk siswa kelas VII SMP tahun ajaran 2017/2018. *Biology and Education Journal*, 25–37.

Othman, M. K., Mat, R., & Sim, K. C. (2025). *A systematic review of paper-based and digital board*

games for collaborative science learning. Review of Education, 1–53.

Riduwan. (2016). *Skala pengukuran variabel-variabel penelitian.* Bandung, Indonesia: Alfabeta.

Ridwan, Amprasto, Widodo, A., & Azizah, C. N. (2024). Miskonsepsi siswa SMA materi osmoregulasi & sistem ekskresi sebagai dasar pengembangan bahan ajar. *Biodik: Jurnal Ilmiah Pendidikan Biologi, 10*(2), 229–237.

Salmawati, Mustami, M. K., & Taufiq, A. U. (2019). Pengembangan media pembelajaran monopoli pada sistem saraf di kelas XI SMAN 1 Wonomulyo Kabupaten Polewali Mandar. *Jurnal Al-Ahya, 1*(3), 57–73.

Shidik, M. A. (2020). Hubungan antara motivasi belajar dengan pemahaman konsep fisika peserta didik MAN Baraka. *Jurnal Kumparan Fisika, 3*(2), 91–98.

Simorangkir, A., & Napitupulu, M. A. (2020). Analisis kesulitan belajar siswa pada materi sistem ekskresi manusia. *Jurnal Pelita Pendidikan, 8*(1), 1–11.

Sugiharti, N., & Gayatri, Y. (2020). Profil kemampuan berpikir kritis siswa SMA Muhammadiyah Kota Surabaya pada pembelajaran biologi. *Jurnal Pedago Biologi, 9*(1), 34–40.

Yuliana, Anindita, H. A., & Syaifuddin, M. W. (2021). Pengaruh konsentrasi belajar dan lingkungan belajar terhadap hasil belajar matematika pada pembelajaran daring. *PRISMA, 10*(2), 141–155.

Zaitsev, I. V. (2021). *Conjunctional concepts: The conceptual teaching technique in biology classes. Journal of Microbiology & Biology Education, 22*(3), 1–6.

Zhang, J., Yen, S.-H., & Liu, T.-C. (2022). *Studies on learning effects of AR-assisted and PPT-based lectures. Asia-Pacific Education Researcher, 31*(1), 1–10.