Proceeding of Integrative Science Education Seminar Vol. 5 No. 1, 2025, pp. 73 - 77

Available online at

PISCES

Proceeding of Integrative Science Education Seminar

Beranda prosiding : https://prosiding.iainponorogo.ac.id/index.php/pisces

Artikel

The Effect of Using 3D-Based Digestive System Learning Media on Junior High School Students' Understanding

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Article Info

5st AVES
Annual Virtual Conference of Education and Science 2025

Keywords:

3D media,
simple teaching aids,
digestive system,
conceptual understanding,
junior high school students

ABSTRAK

Students' understanding of the concept of the human digestive system is still low due to the abstract nature of the material and the limitations of learning media that can describe the process in a realistic manner. This study examines the effect of using simple three-dimensional (3D) learning media on the topic of the human digestive system. The media used is a transparent tube connected from the mouth to the anus and filled with green water to illustrate the passage of food through the body, providing a more concrete and easily understandable picture for students. This study used a quasi-experimental design (pretest-posttest control group) with 50 eighth-grade students from SMPN 15 Bengkulu City as subjects, divided into two groups: an experimental group using 3D media and a control group using conventional learning. Data were collected through a concept comprehension test, which was then analyzed using an independent sample t-test to examine whether there was a significant difference between the two groups. The results of the analysis showed a significant difference between the two groups, with $t = 10.66$ and $p < 0.001$, indicating that 3D media had a greater impact on improving students' concept comprehension. The average increase in scores for the experimental group (17.48 ± 2.73) was higher than that of the control group (7.88 ± 3.59). These findings indicate that simple physical 3D models can effectively improve students' understanding of the digestive system and are recommended as an alternative learning medium in schools with limited technological resources.

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INTRODUCTION

The Natural Sciences curriculum at the junior high school level is designed to develop conceptual understanding, scientific process skills, and scientific attitudes that enable students to apply them in their daily lives (Kemendikbudristek, 2022). One of the topics studied at this level is the human digestive system. This material is very important because it is directly related to vital bodily functions and human health. However, in reality, students still have difficulty understanding this material. The human digestive system is a challenging topic because it is abstract and involves many scientific terms that are difficult for students to understand. Research results show that students' understanding is low, influenced by a lack of interest in learning, difficult scientific terms, and limitations of the learning media used (Muderawan et

al., 2019). This situation highlights the need for learning media that can present the digestive process in a more concrete and easy-to-understand manner.

A number of studies show that technology-based media, such as animated videos, augmented reality (AR), and virtual reality (VR), can help students understand biological concepts better (Jurnal Kajian Teknologi Pendidikan et al., 2020; Nurhidayanti* et al., 2022; Rahmawati et al., 2021). The use of AR-based media supports the visualization of digestive organs in three dimensions, while animations show the digestive process in a realistic manner. However, the use of this technology still faces obstacles (Kementerian Pendidikan dan Kebudayaan, 2017). Not all schools have adequate equipment, stable internet access, or teachers who are familiar with operating such technology. This situation has resulted in the uneven implementation of digital media, especially in schools with limited resources (Haqiqi, 2018; Ritonga, 2017).

Several studies mention that the use of simple props or simple manipulative media can improve students' understanding of science concepts. For example, research by Sulistiyono & Triyanti at Sumber Rejo State Junior High School shows that *Outdoor learning-based science learning effectively improves science process skills* and mastery of concepts (Sulistiyono & Triyanti, 2024). Similarly, studies *Student response to the effectiveness of simple props as a physics learning medium in Charles's Law materials at the BPPT Darus Sholah Jember High School* found that simple media are very effective as learning aids in physics (Sulistiyowati et al., 2022). This involvement can encourage creativity, train motor skills, and strengthen conceptual understanding through direct learning experiences (hands-on learning). However, studies that specifically examine the effectiveness of simple media on the topic of the human digestive system in junior high schools are still limited. Most studies emphasize the use of digital media, while simple contextual media are rarely explored.

As a follow-up to these conditions, this study focused on testing the extent to which a simple physical three-dimensional (3D) model of the digestive system could improve junior high school students' understanding of the concept. The media used was a teaching aid representing the human digestive tract using transparent tubes connected from the mouth to the anus. The tubes were filled with green-colored water to simulate the passage of food through the digestive system. This media was chosen based on the availability of easily obtainable materials, low cost, and ease of assembly, making it suitable for use in schools with limited facilities. Thus, this study not only offers a practical and contextual media alternative but also enriches students' learning experiences through hands-on learning.

METHOD

This study uses a quantitative approach with a quasi-experimental research design. The design used is *pretest–posttest control group design*, which allows researchers to compare learning outcomes between the experimental group and the control group. The experimental group used physical 3D models in the form of teaching aids made of hoses and plastic bottles that showed the digestive process in concrete terms, while the control group used conventional learning methods through lectures and discussions.

The object of this study is the use of 3D digestive system learning media on student understanding. The research subjects were eighth-grade students at SMPN 15 Bengkulu City, who were selected purposively based on academic ability. The sample consisted of two classes, each with 25 students, for a total of 50 students. The study was conducted in three main stages, namely:

1. Preparation stage: includes the preparation of research instruments, the creation of 3D learning media, testing of instruments, and the determination of experimental and control classes.

2. Implementation stage: administering a pretest to both groups, conducting learning according to the predetermined treatment, and administering a posttest after learning is complete. The use of pretests and posttests as data collection tools is in line with the methodology used in educational research to measure changes in student understanding.(Johnson & Christensen, 2017)
3. Analysis stage: processing and analyzing test data to determine the effect of media on student comprehension.

Data were collected using a test of understanding of the digestive system. The test instrument was in the form of multiple choice questions with five answer options, covering cognitive indicators at the levels of remembering (C1), understanding (C2), and applying (C3) based on Bloom's revised taxonomy. The content validity of the instrument was consulted with lecturers who are experts in biology education, while reliability was calculated using the Kuder-Richardson (KR-20) formula.

The data were analyzed quantitatively using an independent sample t-test. The t-test was chosen because it can show whether there is a significant difference in understanding between the experimental group and the control group. Before conducting the t-test, prerequisite tests were carried out, including a normality test using Kolmogorov-Smirnov and a homogeneity test using Levene's Test. The entire analysis process was carried out using SPSS software.

RESULTS AND DISCUSSION

This study aims to determine the effect of using simple three-dimensional (3D) learning media on junior high school students' understanding of the human digestive system. Data were obtained through *pretest* and *posttest* given to two groups, namely the experimental group using 3D media and the control group using conventional learning. Before testing the hypothesis, a prerequisite analysis test was conducted, which included normality and homogeneity tests. The results of the normality test using Shapiro–Wilk showed that the data on the increase in scores (*gain score*) both groups had a significance value of < 0.05, indicating that the data was not normally distributed. However, with a sample size of 25 students in each group, based on the principle *Central Limit Theorem*, parametric test (*independent sample t-test*) can still be used to test the difference in means between groups (Ghasemi & Zahediasl, 2012). Meanwhile, the results of the homogeneity test using Levene's Test showed a significance value of 0.509 ($p > 0.05$), indicating that the variance of the two groups was homogeneous.

Table 1. Recapitulation of Pretest, Posttest, and Difference (Gain Score) Scores

Kelompok	Rata-rata Pretest	SD	Rata-rata Postest	SD	Rata-rata gain	SD
Eksperimen	54,2	11,87	86,2	5,26	**32**	7,91
Kontrol	48,8	7,81	60	6,77	**11,2**	6,17

Based on Table 1, the average pretest scores of the two groups were relatively balanced before the treatment. After the treatment, there was a significant increase in the experimental group compared to the control group. The average increase in scores (gain score) in the experimental group was 32.0 ± 7.91, while in the control group it was only 11.2 ± 6.17. The results of the independent sample t-test showed a t-value of 10.37 with $p< 0.001$, which means that there was a significant difference between the experimental group and the control group. Thus, the null hypothesis (H_0) was rejected and the alternative hypothesis (H_1) was accepted.

The results of the study show that the use of 3D learning media based on physical models of the human digestive system significantly improves junior high school students' understanding of scientific concepts, especially in visualizing the digestive process, which was previously difficult to understand using conventional methods. This media helps students understand the interrelationships between organs, the functions of each part, and the journey of food more clearly. These findings are consistent with previous studies that confirm that 3D models are effective in transforming abstract concepts into visual representations that are easier to learn. (Babalola et al., 2022).

Theoretically, these results are consistent with Piaget's constructivist view, which emphasizes that knowledge is acquired through direct interaction with objects. (Piaget, 1972). In this study, 3D media provided students with the opportunity to observe, hold, and explore models of teaching aids, enabling them to construct new knowledge schemes based on concrete experiences. This hands-on approach has been proven to optimize information storage in memory and encourage critical thinking processes, as students not only listen to verbal explanations but also interpret the digestion process through direct observation.

In addition, the effectiveness of 3D media can also be explained through Paivio's Dual Coding Theory. (Paivio, 1990). The simultaneous integration of verbal and visual information helps to enhance cognitive activity, making complex concepts easier to understand. Three-dimensional visualizations of digestive organs and colored food flow simulations allow the brain to process information through both language and imagery simultaneously, ultimately improving student comprehension.

In terms of learning motivation, the use of 3D media also has a positive impact. Media that displays real organ shapes and colored fluid flow is able to attract students' attention, increase focus, and stimulate curiosity, in accordance with the ARCS (Attention, Relevance, Confidence, Satisfaction) principle proposed by Keller. (Keller, 2010). Thus, learning becomes more interactive, enjoyable, and meaningful, which leads to increased interest and motivation in learning science.

These findings are also supported by previous studies. Research by Ramadani (Ramadani et al., 2025) shows that the use of 3D models in sensory system materials effectively improves students' understanding and active participation in learning. Research by Sulistiyowati (Sulistiyowati et al., 2022) It also proves that simple props can improve learning outcomes through meaningful direct experiences, indicating that simple media can be an effective alternative in science education.

When compared to Rahmawati's research (Rahmawati et al., 2021) Using virtual reality (VR) technology, this study shows similarities in improving conceptual understanding, but with differences in media characteristics. VR media requires special technological devices, while physical models made from simple materials are easier to make, cheaper, and can be applied in schools with limited facilities. This comparison proves that both digital and physical visualizations are equally effective, but the use of simple media is more contextual and inclusive for all schools.

Furthermore, learning experiences using 3D media also strengthen students' memory, as they are actively involved in the exploration process. This is in line with the principles of

science learning, which emphasize the importance of scientific process skills, exploration, and direct observation.(Kemendikbudristek, 2022).

Overall, this study confirms that concrete learning media in the form of 3D models are an effective alternative to help students understand abstract science concepts. Teachers can use simple materials such as transparent tubes, colored water, plastic bottles, and flexible pipes to create easy-to-use and low-cost teaching aids. This approach is in line with the principles of low-cost science education, which emphasizes the use of local materials and simple tools to create interactive and meaningful science learning even in schools with limited facilities. (Alves et al., 2020).

As a follow-up, further research could test the effectiveness of simple 3D media on other science topics, such as the respiratory system, blood circulation, or excretion, in order to expand its contribution to science learning. The combination of physical media and digital technology also has the potential to produce more interactive learning innovations that are in line with the demands of the 21st century.

CONCLUSION

This study concludes that the use of simple three-dimensional (3D) learning media has a significant effect on improving junior high school students' understanding of the human digestive system. 3D media helps students understand abstract material through concrete visualization and encourages active participation in learning. These findings are in line with constructivist theory, which emphasizes the importance of direct experience, so that 3D media can be used as an effective and easily implemented alternative for contextual learning, especially in schools with limited technology.

ACKNOWLEDGMENTS

The author would like to thank the school for granting permission and providing support for this research, as well as the teachers and students who participated enthusiastically throughout the learning process. Thanks are also extended to the supervising lecturer and colleagues who provided advice, guidance, and motivation in the preparation of this article. The support and cooperation of various parties played an important role in the successful completion of this research.

REFERENSI

Alves, G. H. V. S., Fragel-Madeira, L., de Azeredo, T. V., Castro, H. C., Pereira, G. R., & Coutinho-Silva, R. (2020). Low-Cost Scientific Exhibition: A Proposal to Promote Science Education. *Creative Education*, *11*(05), 760–782. https://doi.org/10.4236/ce.2020.115055

Babalola, E. O., Ekunola, G. T., & Omolafe, E. V. (2022). Effects of 3-Dimensional Model of Human Digestive System on Students Performance in Biology Concept in Nigeria. *Journal of Digital Learning and Education*, *2*(3), 187–195. https://doi.org/10.52562/jdle.v2i3.431

Ghasemi, A., & Zahediasl, S. (2012). Normality tests for statistical analysis: A guide for non-

statisticians. *International Journal of Endocrinology and Metabolism*, *10*(2), 486–489. https://doi.org/10.5812/ijem.3505

Haqiqi, A. K. (2018). Analisis Faktor Penyebab Kesulitan Belajar Ipa Siswa Smp Kota Semarang. *Edu Sains: Jurnal Pendidikan Sains & Matematika*, *6*(1), 37. https://doi.org/10.23971/eds.v6i1.838

Johnson, B., & Christensen, L. B. (2017). Educational research : quantitative, qualitative, and mixed approaches. In *TA - TT* - (Sixth edit). SAGE Publications, Inc. https://doi.org/LK - https://worldcat.org/title/950202240

Jurnal Kajian Teknologi Pendidikan, J., Aprilia Fitriani, A., Ulfa, S., & Pramono Adi, E. (2020). PENGEMBANGAN VIDEO PEMBELAJARAN ANIMASI SISTEM PERNAPASAN MANUSIA SEBAGAI UPAYA MENDUKUNG KEBIJAKAN BELAJAR DI RUMAH Article History. *Agustus*, *3*(3), 303–316. https://doi.org/10.17977/um038v3i32020p303

Keller, J. M. (2010). Motivational Design for Learning and Performance. *Motivational Design for Learning and Performance*. https://doi.org/10.1007/978-1-4419-1250-3

Kemendikbudristek. (2022). Capaian Pembelajaran Mata Pelajaran Ilmu Pengetahuan Alam (IPA) Fase D. *Pusat Kurikulum Dan Pembelajaran, Badan Standar, Kurikulum, Dan Asesmen Pendidikan, Kementerian Pendidikan, Kebudayaan, Riset, Dan Teknologi*, *3*, 103–111.

Kementerian Pendidikan dan Kebudayaan. (2017). *Materi Bimbingan Teknis Fasilitator dan Instruktur Kurikulum 2013 Tahun 2017 Sekolah Menengah Pertama Mata Pelajaran Ilmu Pengetahuan Alam*. 176.

Muderawan, I. W., Wiratma, I. G. L., & Nabila, M. Z. (2019). Analisis Faktor-faktor Penyebab Kesulitan Belajar Siswa Pada Pelajaran Kimia. *Jurnal Pendidikan Kimia Indonesia*, *3*(1), 17–23. https://ejournal.undiksha.ac.id/index.php/JPK/article/view/20944

Nurhidayanti*, A., Nofianti, E., Kuswanto, H., Wilujeng, I., & Suyanta, S. (2022). Analisis Kemandirian Belajar Peserta Didik SMP Melalui Implementasi LKPD Discovery Learning Berbantuan Augmented Reality. *Jurnal Pendidikan Sains Indonesia*, *10*(2), 312–328. https://doi.org/10.24815/jpsi.v10i2.23719

Paivio, A. (1990). *Mental Representations: A dual coding approach*. Oxford University Press. https://doi.org/10.1093/acprof:oso/9780195066661.001.0001

Piaget, J. (1972). Psychology and epistemology: towards a theory of knowledge. In *Penguin university books TA - TT* -. Penguin. https://doi.org/ LK - https://worldcat.org/title/633285

Rahmawati, S., Paradia, P. A., & Noor, F. M. (2021). Meta Analisis Media Pembelajaran Ipa Smp/Mts Berbasis Virtual Reality. *OPTIKA: Jurnal Pendidikan Fisika*, *5*(1), 12–25. https://doi.org/10.37478/optika.v5i1.752

Ramadani, A. F., Danuji, S., & Fatimah, F. (2025). Penggunaan Alat Peraga Model 3D dalam Meningkatkan Penguasaan Konsep Siswa pada Materi Sistem Indra. *BIOSFER: Jurnal Biologi Dan Pendidikan Biologi*, *10*(1), 22–27. https://journal.unpas.ac.id/index.php/biosfer/article/view/26564

Ritonga, N. (2017). Analisis Penggunaan Media Berbasis Teknologi Informasi Dan Komunikasi Dalam Proses Pembelajaran Biologi Di Smp Negeri Se-Kec. Medan Kota Analysis of the Usage Information Techology Base and Communication in Learning Process of Biology At Smpn All Medan Ci. *Cahaya Pendidikan*, *3*(1), 77–87. https://doi.org/10.33373/chypend.v3i1.872

Sulistiyono, S., & Triyanti, M. (2024). the Effectiveness of Outdoor Learning-Based Ipa Learning on Concept Mastery and Science Process Skills of Students in Class Viii Smp Negeri Sumber Rejo. *Jurnal Bioedukatika*, *11*(1), 23–28. https://doi.org/10.26555/bioedukatika.v11i1.28972

Sulistiyowati, A., Mahardika, I. K., Subiki, S., Afitah, S. N., Mukarromah, L., & Riskiyanti, T.

D. (2022). Student Response To the Effectiveness of Simple Props As a Physics Learning Media in Charles Law Materials At Sma Unggulan Bppt Darus Sholah Jember. *JPF (Jurnal Pendidikan Fisika) Universitas Islam Negeri Alauddin Makassar*, *10*(2), 88–93. https://doi.org/10.24252/jpf.v10i2.29239