



The Effectiveness of Using Animated Audio-Visual Media on Student Learning Outcomes Regarding the Excretory System Topic for Grade VIII Junior High School Students

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Abstract: This study aimed to examine the effectiveness of animated audio-visual media on students' learning outcomes in the excretory system topic among Grade VIII students at SMP Plus Miftahul Huda Tegalmulya. A quantitative quasi-experimental approach with a one-group pretest-posttest design was employed, involving 14 students selected through simple random sampling. Data were collected using a 20-item multiple-choice test, a 20-statement Likert-scale questionnaire, and observation sheets. The results showed a significant improvement in learning outcomes, with the mean pretest score increasing from 33.21 to 77.14 on the posttest, representing a gain of 43.93 points. The paired sample t-test confirmed statistical significance ($p = 0.001 < 0.05$), and the N-Gain score of 65.50% indicated a "quite effective" category. Students' overall responses to the media reached 75%, classified as effective, while observer-rated student enthusiasm averaged 93.33%, categorized as very good. The implementation of the Discovery Learning model integrated with animated audio-visual media achieved 90%, classified as very effective. These findings suggest that animated audio-visual media, when integrated with active learning models, can effectively enhance both cognitive achievement and student engagement in biology education.

Keywords: Animated Audio-Visual Media; Learning Outcomes; Excretory System

Introduction

Education constitutes a fundamental pillar in shaping individuals' cognitive, emotional, and social development, serving not merely as a mechanism for knowledge transfer but as a lifelong process of holistic human growth (Faisal & Adi, 2023; Wahyuni, 2021). According to Sari et al (2024), effective education integrates intellectual, moral, and spiritual dimensions to prepare learners for the complexities of contemporary society. However, the rapid advancement of technology and shifting pedagogical paradigms demand that educators continuously innovate their instructional strategies to maintain relevance and effectiveness in the classroom (Fricitarani et al., 2023; Putri & Efriyanti, 2025).

Despite these imperatives, instructional practices in many schools still rely heavily on conventional

methods such as lectures and textbook-based learning, which often fail to engage students actively or facilitate deep conceptual understanding (Paling et al., 2024). This is particularly evident in science education, where abstract biological processes—such as those within the excretory system—require visualization beyond verbal explanation (Darman et al., 2024). Students frequently struggle to comprehend internal physiological mechanisms like renal filtration, urine formation, and metabolic waste elimination when these concepts are presented solely through text or oral instruction (Han & Ellis, 2022).

Audio-visual media, particularly animated videos, offer a promising solution to these pedagogical challenges by simultaneously engaging auditory and visual channels, thereby enhancing comprehension, retention, and motivation (Nurfadhillah et al., 2021;

Yusnarti et al., 2022). Research by Ahmad et al (2020) demonstrated that audio-visual media significantly improved students' learning outcomes on the excretory system topic, yielding a high N-Gain score of 0.74. Similarly, Afidah et al (2023) reported that animation-based media achieved an N-Gain of 0.71 and received positive student responses, while Wiwik et al (2022) confirmed the effectiveness of audio-visual media in improving science learning outcomes with a moderate effect size.

Preliminary observations conducted at SMP Plus Miftahul Huda Tegalmulya revealed that students' average scores in science subjects remained below the Minimum Mastery Criteria (KKM), attributed largely to the absence of engaging instructional media, limited student participation, and the abstract nature of the material being taught. These findings align with the broader literature indicating that without appropriate pedagogical tools, students' motivation and conceptual understanding in biology remain suboptimal (Fernando et al., 2024; Muali & Muafiq, 2025).

Therefore, this study aims to examine the effectiveness of animated audio-visual media on learning outcomes related to the excretory system among Grade VIII students at SMP Plus Miftahul Huda Tegalmulya. Specifically, it investigates the improvement in cognitive achievement, students' responses to the media, and the level of enthusiasm during the learning process. The findings are expected to contribute empirical evidence supporting the integration of technology-based media in biology instruction and to provide practical recommendations for educators seeking to enhance instructional quality in the digital era (Fridayanti et al., 2022; Kotimah, 2024).

Method

This study employed a quantitative quasi-experimental approach with a one-group pretest-posttest design to examine the effectiveness of animated audio-visual media on students' learning outcomes in the excretory system topic. The research was conducted at SMP Plus Miftahul Huda Tegalmulya from April 20 to June 13, 2025, involving Grade VIII students. The population comprised 52 students across three grade levels, and the sample consisted of 14 Grade VIII students selected through simple random sampling (probability sampling). The independent variable was the animated audio-visual media (sourced from YouTube), while the dependent variable was students' learning outcomes measured in the cognitive domain. Instruction was delivered using the Discovery Learning model integrated with animated audio-visual media across three treatment

sessions, preceded by one session for instrument testing in Grade IX.

Data were collected through three instruments: a 20-item multiple-choice test measuring cognitive achievement aligned with four learning indicators, a 20-statement Likert-scale questionnaire (SS = 4, S = 3, TS = 2, STS = 1) assessing students' responses across five indicators (understanding, insight, motivation, interest, and perceived benefits), and an observation sheet containing 10 statements to evaluate student enthusiasm and instructional implementation. All instruments underwent validity testing (item-total correlation with r-table at 0.3783), expert validation, reliability analysis (Cronbach's Alpha = 0.846), difficulty level assessment, and discrimination index evaluation prior to administration. Data analysis was performed using IBM SPSS Statistics version 27, comprising prerequisite tests (Shapiro-Wilk normality test and Levene's homogeneity test), N-Gain calculation to measure learning improvement, descriptive statistics, and a Paired Sample t-test to determine the statistical significance of the difference between pretest and posttest scores at a significance level of $\alpha = 0.05$.

Results and Discussion

Results

Improvement of Students' Cognitive Learning Outcomes on the Excretory System

Students' initial ability was measured through a pretest consisting of 20 validated multiple-choice items administered before the implementation of animated audio-visual media. The results revealed that students' mastery of the excretory system material was generally low, with an average score of only 31.43%. The lowest achievement appeared in the indicators of identifying the definition of the excretory system and its organs and determining how to maintain the health of excretory organs, both of which obtained 28.57%. This condition confirmed the preliminary observation that conventional teaching had not been able to help students comprehend abstract physiological processes such as filtration, reabsorption, and augmentation. The pretest also functioned as a diagnostic tool to identify which excretion concepts were most difficult for students prior to the treatment. Hence, the low pretest scores provided a clear empirical baseline against which the effect of the intervention could be measured.

Table 1. Pretest and Posttest Results per Learning Indicator

No	Learning Indicator	Pretest Score	Posttest Score	Gain
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1	Identifying the definition of the excretory system and its organs	28.57%	76.78 %	+48.2 1%
2	Analyzing the organs of the excretory system and their functions	35.71%	72.22 %	+36.5 1%
3	Identifying diseases of the excretory organs	32.86%	80.00 %	+47.1 4%
4	Determining how to maintain the health of excretory organs	28.57%	92.86 %	+64.2 9%
Average		31.43%	80.47 %	+49. 04%

Table 1 demonstrates that every learning indicator experienced a substantial increase after three meetings of instruction using animated audio-visual media. The most considerable improvement occurred in the fourth indicator, determining how to maintain the health of excretory organs, which rose 64.29 percentage points to reach 92.86%. Overall, the mean score climbed from 31.43% to 80.47%, reflecting an aggregate gain of nearly 49%. Such a consistent pattern indicates that visual representation of excretory processes helped students construct more accurate and complete conceptual understanding. Moreover, the posttest mean score of 77.14 placed students' achievement in the "good" (B) category according to the applicable learning standard. Thus, the descriptive data provide initial evidence supporting the effectiveness of the implemented media.

Prerequisite Tests and Hypothesis Testing Results

Before the hypothesis test was performed, the assumptions of normality and homogeneity were verified using the Shapiro-Wilk test and Levene's test through IBM SPSS version 27. The normality test produced significance values of 0.790 for the pretest and 0.548 for the posttest, both exceeding the 0.05 threshold, which indicates that the data were normally distributed. Furthermore, the homogeneity test yielded a significance value based on mean of 0.512, confirming that the variances of the two data sets were homogeneous. These assumption tests were essential because they determined whether

parametric or non-parametric statistics should be employed for hypothesis testing. Since both prerequisites were satisfied, a parametric test in the form of the paired sample t-test was judged appropriate for analyzing the score difference. This careful verification ensured that the statistical conclusion drawn in this study was valid and methodologically sound.

Table 2. Summary of N-Gain and Paired Sample t-Test Results

Statistic	Value	Interpretation
Mean N-Gain	65.50%	Quite effective
N-Gain Std. Deviation	0.16062	Relatively homogeneous gain
t value	-12.905	Strong treatment effect
df	13	
Sig. (2-tailed)	0.001	Significant (p < 0.05)
Mean Difference	-43.929	Posttest higher than pretest

Table 2 summarizes the inferential analysis that confirms the effectiveness of the animated audio-visual media. The paired sample t-test produced a two-tailed significance value of 0.001, far below the alpha level of 0.05, so the null hypothesis was rejected. This result indicates that the difference between pretest and posttest scores was statistically significant and cannot be attributed to chance. In addition, the mean N-Gain of 65.50% fell within the "quite effective" category, showing a consistent and meaningful improvement across students. The N-Gain standard deviation of 0.16 demonstrates that, although the magnitude of improvement varied among individuals, the overall response remained relatively homogeneous. Taken together, these statistical indicators offer strong quantitative evidence of the media's positive impact.

The rejection of the null hypothesis means that the implementation of animated audio-visual media exerted a genuine effect on students' mastery of excretory system concepts. The t value of -12.905 reflects a very strong treatment effect relative to the variability of score differences within the group. In practical terms, nearly all students experienced meaningful progress, with individual N-Gain values ranging from 0.38 to 0.93. Students with the highest gain achieved near-maximal improvement, whereas those with the lowest gain still demonstrated moderate but meaningful advancement. Therefore, the inferential results consolidate the descriptive

evidence and confirm that the improvement is attributable to the instructional intervention rather than to extraneous factors.

Students' Responses toward the Use of Animated Audio-Visual Media

Students' responses were measured through a 20-statement Likert-scale questionnaire covering five indicators, namely understanding, insight, motivation, interest, and perceived benefits. The overall analysis produced a score of 75%, which falls within the "effective" category according to the applied effectiveness criteria. The cumulative distribution of responses showed that 42.01% of answers were strongly agree and 32.18% agree, whereas disagree and strongly disagree accounted for only 13.94% and 11.87%, respectively. This dominance of positive responses indicates that students generally welcomed the use of animation media in science learning. The questionnaire was administered after the posttest in order to capture students' overall perception of the learning experience they had just completed. The detailed results for each indicator are presented in Table 3 to illustrate the variation in students' perceptions.

Table 3. Recapitulation of Students' Response Percentages per Indikator

Indicator	Percentage	Category
Understanding	75.89%	Effective
Insight	75.35%	Effective
Motivation	76.33%	Effective
Interest	63.83%	Quite effective
Benefits	88.95%	Very effective
Overall	75.00%	Effective

Table 3 reveals that the highest achievement was obtained on the benefits indicator at 88.95%, showing that students genuinely felt helped by the media in mastering the material. The understanding, insight, and motivation indicators also scored above 75%, reinforcing the perception that animation made abstract concepts easier and more enjoyable to learn. In contrast, the interest indicator obtained the lowest score of 63.83%, suggesting that some students felt the attractiveness of the media declined with repeated viewing. This finding implies that variation in video content and the addition of interactive elements, such as quizzes or gamification, are needed to sustain attention. In other words, students recognized that the media not only eased learning but also broadened their insight into excretory phenomena in daily life. Nevertheless, the overall response pattern supports the conclusion that the animated audio-visual media were well received by the students.

The questionnaire findings were reinforced through informal interviews conducted with several students after the learning sessions concluded. One student stated, *"The animation video made it easier for me to understand how the kidneys filter blood; I could see the process directly, so I did not have to imagine it only from the textbook."* Another student expressed, *"I was more excited to study because the video was fun and did not make me sleepy, but I hope the teacher uses different videos so we do not get bored."* These statements align with the high scores on the benefits and motivation indicators as well as the relatively lower score on interest. Such voices emphasize that the perceived usefulness of the media is the main driver of the positive overall response. Thus, the qualitative data corroborate and clarify the quantitative findings obtained from the questionnaire.

Students' Enthusiasm during the Learning Activities

Students' enthusiasm was observed by two observers, the science subject teacher and the mentoring teacher, across three meetings using an observation sheet consisting of ten statements. The observed aspects included attention to the teacher's explanation, orderly and note-taking behavior, and active participation during discussion and video viewing. The observation results showed consistently high percentages, namely 90% in the first meeting, 100% in the second, and 90% in the third, with an overall average of 93.33%. This value falls within the "very good" category and indicates strong student engagement throughout the intervention. The use of two independent observers was intended to increase the objectivity and reliability of the recorded observation data. The slight decline in the third meeting was attributed to a few students who displayed signs of boredom toward the end of the session.

Table 4. Observation Results of Students' Enthusiasm across Three Meetings

Meeting	Maximum Score	Achieved Score	Enthusiasm Percentage	Category
1	20	18	90%	Very good
2	20	20	100%	Very good
3	20	18	90%	Very good
Total	60	54	93.33%	Very good

Table 4 shows that students' enthusiasm remained at a very high level throughout the learning process using animated audio-visual media. The peak achievement in the second meeting indicates that students had fully adapted to the Discovery Learning syntax and actively engaged in discussion and presentation. Meanwhile, the minor declines in the first and third meetings were related to some students daydreaming during the initial session and expressing boredom during the final session. Nevertheless, the fact that the percentage never dropped below 90% demonstrates the strong and sustained attractiveness of the animation media. Such active emotional involvement created a classroom atmosphere that was conducive to meaningful learning. This enthusiasm constitutes an important affective component that supports the cognitive improvement reported in the previous sections.

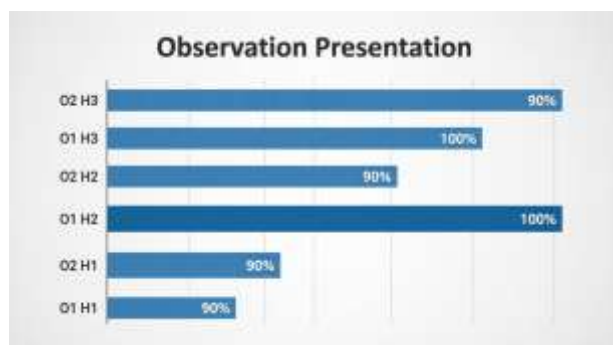


Figure 1. Diagram of Observation Percentage Results.

The observation trend is visualized in Figure 1 of the draft, which displays the fluctuation of enthusiasm percentages across the three meetings. The diagram shows a peak in the second meeting and a slight decrease in the third, consistent with the narrative explanation above. The mentoring teacher, acting as Observer 2, stated, "Students who usually daydreamed or left the classroom paid far more attention when the animation was displayed, and even in the last meeting the class remained conducive." This qualitative information explains the small decline in the third meeting without diminishing the overall very good category. The convergence of observation and interview data strengthens the validity of the conclusion regarding student engagement. Therefore, the observation data confirm that the animated audio-visual media were able to maintain a high level of student involvement during the learning activities.

Implementation of Discovery Learning Integrated with Animated Audio-Visual Media

The implementation of learning was evaluated through an observer sheet that recorded the extent to

which each stage of the Discovery Learning syntax was executed in every meeting. The assessed stages included communicating objectives and benefits, providing triggering questions, displaying the animation video, distributing worksheets, guiding group discussion, conducting presentation and question-and-answer sessions, and performing closing reflection. The results revealed a clear upward trend: 80% in the first meeting, 90% in the second, and 100% in the third, with an average of 90% classified as very effective. The unimplemented stages in the early meetings were mainly the explicit communication of objectives and the final reflection, which were constrained by limited time management. This observation was important to ensure that the learning outcomes achieved were truly the result of the designed instructional scenario. The gradual improvement indicates the teacher's ability to adapt after evaluating the implementation of the previous meeting.

Table 5. Implementation Results of Discovery Learning per Meeting

Meet ing	Impleme nted	Not Impleme nted	Percen tage	Categ ory
1	8	2	80%	Good
2	9	1	90%	Very good
3	10	0	100%	Very good
Average			90%	Very effect ive

Table 5 details the progressive improvement in the quality of learning implementation across the intervention. In the first meeting, two stages could not be completed because the available time was absorbed by group discussion and presentation of results. In the second meeting, the teacher successfully corrected the opening stage by stating the objectives clearly, yet reflection remained unexecuted, producing a score of 90%. In the final meeting, all syntax was fully implemented, including reflection, in which students conveyed their impressions and the teacher reinforced the material's conclusion. This progression demonstrates that the combination of Discovery Learning and audio-visual media can be executed increasingly ideally as the teacher and students adapt. Moreover, the teacher's gradual adaptation shows that reflection on practice is essential for improving the quality of media-based learning implementation.



Figure 2. Percentage of Learning Implementation

The implementation trend is presented in Figure 2 of the draft, which illustrates the steady rise from 80% to 100% across the three meetings. The figure emphasizes that the main obstacle in the early phase was time management rather than incompatibility between the media and the learning model. The science teacher, acting as Observer 1, commented, *"Once I managed the time better, all stages including reflection could be completed, and the animation video actually saved time in explaining difficult material."* This statement confirms that the animated audio-visual media functioned as an efficient and effective stimulus within the Discovery Learning framework. Thus, the three data sources—tests, questionnaires, and observation—provide a comprehensive and mutually reinforcing picture of the media's effectiveness. Overall, the implementation data demonstrate that the designed learning scenario was carried out as planned and strongly supported the achievement of learning outcomes.

Discussion

The findings of this study demonstrate that the integration of animated audio-visual media significantly enhances students' cognitive learning outcomes in the excretory system, as evidenced by a substantial increase from a pretest mean of 33.21% to a posttest mean of 77.14% and an overall N-Gain of 65.50%. This empirical evidence strongly aligns with the broader educational consensus that multimedia tools are indispensable for teaching complex scientific phenomena. According to Harosid (2025), Satar et al (2026), and Widarti et al (2022), audio-visual media significantly elevates academic achievement, particularly in science subjects that demand the visualization of abstract or microscopic processes. By simultaneously stimulating auditory and visual sensory channels, animated media enables students to construct more accurate mental models of physiological mechanisms that are otherwise impossible to observe directly in a traditional classroom setting.

When contextualized within specific biological topics, the current results corroborate and extend the findings of Ahmad et al (2020), who reported a high N-Gain of 0.74 when utilizing general audio-visual media for the excretory system. While Ahmad et al (2020) focused on broad video media, the present study isolates the specific impact of *animation*, achieving a "quite effective" N-Gain category that proves animated simulations are equally potent in demystifying internal organ functions like renal filtration and urine formation. Furthermore, this aligns with Chytas et al (2024) and Saidin & Fei (2023), who confirmed the effectiveness of digital media in teaching the human skeletal system. Together, these studies establish a consistent pattern: whether addressing the skeletal or excretory systems, dynamic visual representations are critical for bridging the gap between abstract textbook descriptions and concrete biological understanding.

The specific advantage of animation over static or live-action video is further supported by Daria et al (2026) and Studi et al (2025) demonstrated that audiovisual animation tools could yield a high N-Gain of 0.71 and foster positive student perceptions by effectively representing abstract science concepts. Similarly, Acquah (2023), Appiah (2024), and Doku (2025) highlighted the profound impact of animated videos in science instruction. The current study's posttest mastery, particularly in the indicator of maintaining organ health (which surged to 92.86%), reflects this exact phenomenon. Animation allows for the manipulation of time and scale—such as slowing down the rapid process of reabsorption in the nephron or zooming into the alveoli—thereby reducing cognitive load and allowing students to process complex sequential biological events at their own pace.

Beyond cognitive gains, the implementation of animated media profoundly influenced the affective domain, yielding an overall effective student response rate of 75% and an exceptional observer-rated enthusiasm score of 93.33%. This high level of engagement is consistent with the assertions of Ahad et al (2025), Daniel et al (2024), Sulaiman & Al Shuaili (2025), and Walker et al (2024) who emphasized that learning motivation is a primary driver of improved academic outcomes. The dynamic nature of animation captures students' attention and mitigates the boredom often associated with conventional lecture-based biology instruction. This is also supported by Wiwik et al (2022), who found that audio-visual media not only improves learning outcomes but also

generates a strong effect size by fostering a highly interactive and enjoyable classroom atmosphere. The students' recognition of the media's benefits (88.95% in the questionnaire) confirms that they perceive animation as a valuable scaffold for their independent learning.

However, the effectiveness of this media is inextricably linked to its pedagogical integration, specifically within the Discovery Learning model utilized in this research. Media alone cannot guarantee deep conceptual change without structured inquiry, a nuance that differentiates successful implementations from purely passive viewing. While the novelty of animation initially spikes interest, the slight decline in enthusiasm during the third meeting (dropping to 90%) suggests that the "novelty effect" may wear off if instructional strategies are not continuously varied. Future research should therefore explore the integration of interactive elements, such as gamification or student-created animations, to sustain long-term motivation. Ultimately, the synthesis of current and past literature from 2020 to 2026 confirms that animated audio-visual media is not merely a supplementary tool, but a fundamental pedagogical necessity for modern biology education, provided it is strategically aligned with active learning frameworks.

Conclusion

This study demonstrates that animated audio-visual media significantly improves students' cognitive learning outcomes on the excretory system topic among Grade VIII students at SMP Plus Miftahul Huda Tegalmulya. The pretest mean score of 33.21% increased substantially to a posttest mean of 77.14%, reflecting an improvement of 43.93 points. The paired sample t-test confirmed this difference as statistically significant (Sig. 2-tailed = 0.001 < 0.05), while the N-Gain score of 65.50% indicated a "quite effective" level of learning improvement. The highest posttest achievement was observed in the indicator of determining how to maintain the health of excretory organs (92.86%), suggesting that animated visualization effectively facilitated students' understanding of both conceptual and applied aspects of the material.

Beyond cognitive gains, the findings reveal positive affective and pedagogical outcomes. Students' overall responses to the media reached 75% (effective category), with the highest score recorded in the perceived benefits indicator (88.95%), while student enthusiasm during learning activities averaged 93.33% (very good category) across three meetings. The implementation of the Discovery Learning model

integrated with animated audio-visual media showed progressive improvement from 80% to 100%, achieving an overall average of 90% (very effective). These results collectively confirm that animated audio-visual media, when strategically embedded within an active learning framework, serve as an effective instructional tool for enhancing both academic achievement and student engagement in biology education.

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