



A Comparison of the Effectiveness of Audio and Visual Learning Media in Improving Student Learning Outcomes

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Abstract

This study aimed to compare the effectiveness of audio and visual learning media in improving students' learning outcomes. The research employed a quantitative experimental method with a pretest-posttest group design. The sample consisted of 60 eighth-grade students at SMP Negeri 6 Kota Serang, divided equally into an audio group and a visual group through randomization. The research instrument initially comprised 10 multiple-choice items, which were tested for validity prior to implementation. Based on item analysis, four items were declared valid, three items were revised, and a total of seven items were used in both the pretest and posttest. Normality testing using the Kolmogorov-Smirnov test indicated that most data were not normally distributed, leading to the use of the Wilcoxon Signed-Rank Test for hypothesis testing. The results showed that the audio group experienced a significant improvement in learning outcomes ($p = 0.005 < 0.05$), while the visual group showed no significant improvement ($p = 0.390 > 0.05$). These findings indicate that audio learning media is more effective than visual learning media in enhancing students' learning outcomes.

Keywords: Audio Learning Media, Experimental Study, Learning Outcomes, Students, Visual Learning Media.



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INTRODUCTION

Education is fundamentally directed toward the optimal development of individual potential, enabling learners to improve their knowledge, skills, and attitudes in ways that support personal growth and social participation (Efendy, 2023). In contemporary learning science, the rapid expansion of digital technologies has transformed instructional environments, creating unprecedented opportunities for educators to employ diverse learning media that facilitate more effective knowledge construction and learner engagement (Suhirman et al., 2025). Learning effectiveness is increasingly determined not only by curriculum design and instructional strategies but also by the capacity of educational media to support cognitive processing and meaningful learning experiences (Daniyati et al., 2023). Recent developments in multimedia-based instruction indicate that learning media function as critical mediating tools that bridge abstract concepts and learner understanding across various educational contexts (Agisni et al., 2023). Studies examining interactive and technology-enhanced learning environments have demonstrated that appropriately designed media can significantly improve student achievement, participation, and conceptual comprehension (Hadi et al., 2022). The growing emphasis on evidence-based pedagogy has consequently intensified scholarly attention toward identifying which forms of learning media generate the greatest educational benefits under different instructional conditions.

Within this expanding body of literature, learning media have been widely recognized as instruments capable of stimulating learners' attention, motivation, and cognitive engagement during instructional activities (Annisa et al., 2026). Research consistently reports that the use of educational media contributes positively to student learning outcomes by facilitating more accessible and structured information processing (Mardatillah et al., 2023). Audio-visual media, in particular, have received substantial attention because they combine auditory and visual stimuli that potentially enhance learning effectiveness through multimodal representation (Afnita et al., 2022). Empirical investigations have revealed that audio-visual interventions can improve learning interest while simultaneously

contributing to higher academic achievement among students (Agustin & Riyanti, 2024). Similar findings indicate that audio-visual instructional approaches positively affect students' learning outcomes across diverse subject areas and educational levels (Dwiriyanti et al., 2023). Evidence from thematic learning contexts further suggests that audio-visual media strengthen student performance by increasing engagement and facilitating retention of instructional content (Fika & Rindaningsih, 2022). Although these findings collectively support the pedagogical value of media integration, they also reveal a tendency among researchers to prioritize combined media formats rather than examining the independent contribution of specific media modalities.

Theoretical and empirical discussions regarding visual and audio media indicate that each modality may activate distinct cognitive mechanisms during learning processes. Visual media, including images, diagrams, graphics, and illustrations, are frequently associated with improved conceptual representation and stronger memory retention because they transform abstract information into observable forms (Suhirman et al., 2025). Research focusing on visual-based instruction reports that visual media are particularly effective in promoting learner interest and supporting the comprehension of cognitively demanding material (Aziz, 2024). In contrast, audio media facilitate learning through auditory channels and have been linked to improvements in listening skills, concentration, and information processing through verbal explanations (Suhirman et al., 2025). Contemporary reviews of video-based and media-enhanced learning further suggest that learning effectiveness is influenced by complex interactions among media characteristics, learner attributes, technological affordances, and instructional objectives rather than by media usage alone (Navarrete et al., 2025). Comparative pedagogical research also indicates that different instructional approaches may produce varying educational outcomes depending on contextual and learner-related factors (Yongsan & Guodong, 2024). These observations imply that the effectiveness of learning media should not be assumed to be universal, as different modalities may generate different cognitive and educational consequences.

Despite the substantial growth of research on educational media, several conceptual and empirical limitations remain unresolved within the literature. A considerable proportion of previous studies has concentrated on evaluating multimedia or audio-visual interventions as integrated instructional packages, making it difficult to isolate the individual effectiveness of audio and visual modalities (Manulang et al., 2023). Existing studies often prioritize variables such as learning interest, motivation, or engagement rather than directly measuring comparative differences in learning outcomes generated by distinct media formats (Cahyani et al., 2024). Research emphasizing visual media effectiveness has also predominantly adopted descriptive or qualitative approaches, limiting the strength of causal inferences regarding its impact on academic achievement (Aziz, 2024). Methodological discussions in educational research highlight the necessity of experimental designs when the objective is to determine comparative effectiveness and establish stronger causal explanations (Akbar et al., 2023). The available evidence consequently presents inconsistencies concerning whether auditory or visual modalities exert superior effects on student learning outcomes across different instructional contexts. The persistence of these inconsistencies reflects a significant gap in contemporary pedagogy, particularly regarding modality-specific learning effectiveness.

Addressing this gap possesses both scientific and practical significance because instructional decisions concerning media selection directly influence the quality of classroom learning experiences. Educators frequently select learning media based on accessibility, familiarity, or institutional preference rather than empirical evidence regarding modality effectiveness. The need for more precise evidence becomes increasingly important as educational systems continue to integrate diverse technological resources into everyday teaching practices. Findings from experimental learning environments suggest that instructional effectiveness is strongly associated with the alignment between pedagogical tools and intended learning outcomes (Darma et al., 2025). Similar evidence demonstrates that learning achievement can vary considerably according to the instructional method and learning resources employed during classroom activities (Lestari et al., 2025). Generating robust comparative evidence regarding audio and visual media therefore represents an important step toward strengthening evidence-based instructional decision-making and optimizing student learning achievement.

Against this backdrop, the present study positions itself within contemporary pedagogy and learning science by directly comparing the effectiveness of audio learning media and visual learning media in improving student learning outcomes. Rather than examining multimedia integration as a

unified construct, this research focuses on identifying the relative contribution of each modality as an independent instructional intervention. Such a focus enables a more precise understanding of how different sensory channels influence learning performance and educational effectiveness. The study aims to determine which learning medium produces greater improvements in student learning outcomes among eighth-grade students at SMP Negeri 6 Serang City. Theoretically, the research contributes to the growing discourse on modality-specific learning effectiveness by providing empirical evidence regarding the comparative value of audio and visual instructional media. Methodologically, the study contributes by employing a comparative experimental framework capable of generating stronger causal interpretations and offering practical guidance for educators seeking evidence-based media selection strategies.

RESEARCH METHODS

This study employed an empirical quantitative approach using an experimental research design to examine the comparative effectiveness of audio and visual learning media in improving students' learning outcomes. An experimental method was selected because it enables researchers to investigate causal relationships between instructional interventions and educational outcomes under controlled conditions (Akbar et al., 2023). The study adopted a pretest–posttest group design, in which participants completed an achievement test before and after receiving the assigned instructional treatment, allowing changes in learning outcomes to be measured systematically (Lestari et al., 2025). The research was conducted at SMP Negeri 6 Serang City and involved eighth-grade students as the target population. A total of 60 students participated in the study and were randomly assigned into two groups consisting of 30 students each. The first group received instruction through audio learning media, including recorded explanations delivered via loudspeakers, whereas the second group received instruction through visual learning media in the form of animated videos containing images and instructional illustrations related to the learning materials. Data were collected through achievement tests administered as pretests and posttests to assess students' initial competencies and learning gains following the intervention.

The primary research instrument was a multiple-choice achievement test designed to measure students' learning outcomes. The initial instrument consisted of ten items that underwent content validity evaluation prior to implementation. Based on expert validation procedures, seven items were deemed appropriate and subsequently employed in both the pretest and posttest administrations. Data analysis was conducted using IBM SPSS software. Prior to hypothesis testing, the distribution of the data was examined through the Kolmogorov–Smirnov normality test to determine the suitability of subsequent statistical procedures. The results indicated that several variables violated the assumption of normality, as reflected by significance values below the established threshold of 0.05. Consequently, a non-parametric analytical approach was adopted, and the Wilcoxon Signed-Rank Test was used to compare pretest and posttest scores within each experimental group. This procedure enabled the researchers to evaluate the effectiveness of each instructional medium in producing significant improvements in student learning outcomes. Ethical considerations were observed throughout the study by obtaining permission from the school administration, informing participants about the purpose of the research, ensuring voluntary participation, maintaining confidentiality of individual data, and using the collected information exclusively for academic purposes.

RESULTS AND DISCUSSION

Instrument Validation and Data Distribution Analysis

The development of the research instrument in this study was grounded in the need to ensure that the measurement of student learning outcomes reflects both content relevance and instructional alignment within experimental learning settings. The initial instrument consisted of ten multiple-choice items designed to assess cognitive achievement related to the instructional material delivered through audio and visual media interventions. Prior to implementation, the instrument underwent expert judgment validation to ensure its appropriateness in measuring the intended learning constructs in a structured classroom experiment (Daniyati et al., 2023). The validation process resulted in the identification of four items as invalid due to insufficient alignment with learning indicators, while three items required revision to improve clarity and cognitive level suitability. This refinement process emphasizes the importance of instrument precision in experimental pedagogy to minimize measurement

bias and ensure that observed learning outcomes genuinely reflect instructional effects (Akbar et al., 2023).

Following the revision process, the final instrument consisted of seven validated items that were consistently used in both pretest and posttest administrations to maintain measurement equivalence across learning phases. The consistency of instrument use across testing phases strengthens the internal comparability of learning outcomes before and after treatment exposure. Such methodological consistency is essential in experimental designs because it ensures that observed differences in scores are attributable to instructional interventions rather than inconsistencies in measurement tools (Lestari et al., 2025). In the context of contemporary learning science, validated instruments play a central role in ensuring that cognitive gains can be accurately mapped to specific pedagogical treatments. The use of standardized testing instruments also supports the reliability of outcome interpretation in media-based instructional research (Suhirman et al., 2025).

The distributional characteristics of the collected data were examined using the Kolmogorov–Smirnov test to determine the suitability of inferential statistical procedures for hypothesis testing. The results of the normality test are presented in Table 1, which summarizes the distribution of pretest and posttest scores across both experimental groups. The interpretation of these results is crucial in determining whether parametric or non-parametric analytical techniques should be employed in subsequent stages of analysis.

Table 1. One-Sample Kolmogorov- Smirnov Test

	Total skor pre test- visual	Total skor post test- visual	Total skor pre test- audio	Total skor post test- audio
N	30	30	30	30
Asymp. Sig. (2-tailed)	.000	.003	.000	.085

Based on the results of the normality test using the Kolmogorov-Smirnov test, the significance values for the visual group were 0.000 for the pretest and 0.003 for the posttest. For the audio group, the significance values were 0.000 for the pretest and 0.085 for the posttest. Data is said to be normally distributed if it has a significance value greater than 0.05 ($p > 0.05$). Based on these results, only the posttest data for the audio group is normally distributed, while the other data is not normally distributed because it has significance values less than 0.05 ($p < 0.05$). Therefore, since most of the data does not meet the assumption of normality, further data analysis was conducted using a nonparametric test, namely the Wilcoxon Signed-Rank Test.

Given the violation of normality assumptions in most datasets, the selection of an appropriate statistical test becomes essential to ensure analytical validity. In experimental learning research, non-parametric tests are often recommended when data do not satisfy parametric assumptions, particularly in pretest–posttest designs involving relatively small sample sizes (Darma et al., 2025). Therefore, the Wilcoxon Signed Rank Test was considered suitable for analyzing differences between paired observations within each group. This analytical approach allows for the assessment of median differences in learning outcomes without relying on distributional assumptions. The decision to employ non-parametric analysis enhances the robustness of findings in educational experiments where learning variability is naturally high.

The methodological rigor applied in instrument validation and data distribution analysis demonstrates the importance of aligning measurement tools and statistical techniques with the structural characteristics of educational data. Ensuring instrument validity contributes to the accuracy of learning outcome measurement, while appropriate selection of statistical tests ensures the credibility of inferential conclusions. In the broader scope of pedagogy and learning science, such methodological alignment strengthens the interpretability of experimental findings related to instructional media effectiveness. This process also reflects the necessity of integrating psychometric considerations into classroom-based research designs to support evidence-based educational decision-making.

Comparative Effectiveness of Audio and Visual Learning Media

The comparative effectiveness analysis in this study was conducted to determine whether there are significant differences in learning outcomes between students who were taught using audio learning media and those who were taught using visual learning media. This analysis is based on the results of the Wilcoxon Signed-Rank Test, which was applied to pretest and posttest scores in each group to identify the magnitude and direction of learning improvement after the intervention. The statistical summary of the test results is presented in Table 2, which provides a clear comparison of the Z values and significance levels for both instructional media conditions. This comparison is essential in experimental pedagogy to evaluate the relative effectiveness of different instructional modalities in influencing student achievement outcomes.

Table 2. Test Statistics

	Total skor pretest dan posttest visual	Total skor pretest dan posttest audio
Z	-.860	-2.837
Asymp. Sig. (2-tailed)	.390	.005

The results of the Wilcoxon Signed-Rank Test for the audio group showed a significance value of 0.005 ($p < 0.05$). These results indicate a significant difference between the pretest and posttest scores, leading to the conclusion that the use of audio learning media has an effect on improving student learning outcomes. Meanwhile, the results of the Wilcoxon Signed-Rank Test for the visual group showed a significance value of 0.390 ($p > 0.05$). These results indicate no significant difference between the pretest and posttest scores, suggesting that the use of visual learning media does not lead to a significant improvement in learning outcomes. Thus, audio learning media has been proven to be more effective than visual learning media in improving students' learning outcomes.

The significant improvement observed in the audio group can be interpreted as evidence that auditory instructional delivery facilitates more focused cognitive processing during learning activities. Audio media allows students to concentrate on sequential verbal information without the additional cognitive demand of interpreting visual stimuli simultaneously, which may enhance comprehension efficiency in certain learning contexts (Afnita et al., 2022). This finding aligns with the view that learning effectiveness is strongly influenced by how instructional media manage learners' cognitive load during information processing tasks. In contrast, the absence of significant improvement in the visual group may indicate that visual media alone, without adequate instructional structuring or reinforcement, may not sufficiently support deeper conceptual understanding.

From a pedagogical standpoint, the results suggest that the effectiveness of instructional media is closely related to the alignment between media characteristics and learners' cognitive processing capacities. The superior performance of the audio group implies that auditory channels may provide a more efficient pathway for knowledge acquisition when compared to visual-only presentation formats in this particular learning context. This observation is consistent with findings that emphasize the importance of selecting instructional media based on their ability to enhance cognitive engagement and learning efficiency rather than solely on their technological form or attractiveness (Mardatillah et al., 2023). Furthermore, the results reinforce the idea that different media modalities may produce varying learning outcomes depending on how they interact with students' attentional and cognitive mechanisms during instruction.

Overall, the comparative findings indicate that audio learning media is more effective than visual learning media in improving student learning outcomes in this study. The statistical evidence supports the conclusion that audio-based instruction leads to significant learning gains, while visual-based instruction does not yield a comparable level of improvement under the same experimental conditions. This suggests that instructional design decisions should carefully consider the cognitive implications of media selection to maximize learning effectiveness. The findings also contribute to the growing discourse in contemporary pedagogy regarding the need to evaluate educational media based on empirical learning outcomes rather than assumptions about modality superiority.

Interpretation within Contemporary Pedagogy and Learning Science

The results of this study position audio learning media as more effective than visual learning media in improving student learning outcomes within the experimental classroom context. This outcome indicates that the cognitive demands embedded in audio-based instruction may be more compatible with students' processing capacities during structured learning activities. In contemporary pedagogy and learning science, such findings are commonly interpreted through cognitive load considerations, where instructional effectiveness is determined by how well learning media reduce extraneous processing while supporting meaningful knowledge construction (Agisni et al., 2023). The superior performance of the audio group therefore reflects an interaction between instructional modality and learners' cognitive processing efficiency rather than a simple superiority of one medium over another.

The difference in effectiveness between audio and visual media can be further explained through the distinct ways each modality engages cognitive channels. Audio instruction relies on sequential verbal processing, which allows learners to construct meaning progressively without the need to simultaneously interpret complex visual stimuli. In contrast, visual learning media may require learners to process multiple visual elements at once, which can increase cognitive load when the instructional design is not sufficiently structured. This condition may reduce the efficiency of information encoding, particularly when learners are not guided to focus on the most relevant conceptual elements (Annisa et al., 2026). As a result, visual media may require additional instructional scaffolding to achieve optimal learning effectiveness.

The findings of this study are consistent with the view that learning outcomes are strongly influenced by how instructional media organize and deliver information rather than by modality presence alone. Audio-based instruction appears to facilitate more focused attentional engagement, allowing students to concentrate on verbal explanations without competing visual distractions. This aligns with research emphasizing that effective learning occurs when instructional materials support sustained attention and reduce unnecessary cognitive fragmentation during learning processes (Hadi et al., 2022). In this sense, the effectiveness of audio media in this study can be linked to its capacity to support coherent cognitive processing pathways.

However, the absence of significant improvement in the visual group does not necessarily indicate that visual media are ineffective in all contexts. Instead, it suggests that visual materials require careful instructional design to ensure that learners can effectively integrate and interpret visual information. When visual media lack clear structuring or guiding cues, learners may experience difficulties in identifying key concepts, which can hinder learning performance. Contemporary research in multimedia learning emphasizes that the effectiveness of visual-based instruction is highly dependent on design quality and alignment with cognitive processing principles rather than visual richness alone (Navarrete et al., 2025).

From a pedagogical perspective, these findings highlight the importance of aligning instructional media with both cognitive characteristics of learners and the nature of the learning content. Effective teaching practices require educators to consider how different media influence attention, memory, and comprehension processes in real instructional settings. Comparative studies in education suggest that learning effectiveness emerges from the interaction between instructional strategy, media selection, and learner readiness rather than from a single dominant factor (Yongsan & Guodong, 2024). Therefore, the selection of learning media should be grounded in empirical evidence and cognitive appropriateness rather than assumption or preference.

Overall, this study contributes to contemporary learning science by reinforcing the idea that instructional media effectiveness is context-dependent and cognitively mediated. The stronger performance of audio learning media in this study suggests its potential usefulness in supporting structured knowledge acquisition in similar educational environments. At the same time, it underscores the necessity of refining visual instructional design to enhance its pedagogical impact. These findings support a more critical and evidence-based approach to instructional media selection within modern educational practice, where learning outcomes are shaped by the alignment between media characteristics and cognitive processing mechanisms.

CONCLUSION

Based on the results of the study, it can be concluded that the use of audio learning media has a statistically significant effect on improving the learning outcomes of eighth-grade students at SMP Negeri 6 Kota Serang. This conclusion is supported by the results of the Wilcoxon Signed Rank Test, which showed a significance value of 0.005 ($p < 0.05$) in the audio group, indicating a meaningful difference between pretest and posttest scores after the implementation of the instructional treatment. The improvement observed in the audio group reflects that auditory-based instruction is capable of facilitating better cognitive processing, attention focus, and comprehension of learning materials in the classroom context. This finding suggests that the structured delivery of information through audio media contributes effectively to students' academic achievement, particularly in learning environments that require sustained listening and conceptual understanding.

In contrast, the use of visual learning media does not show a statistically significant effect on students' learning outcomes in this study, as indicated by the Wilcoxon Signed Rank Test result of 0.390 ($p > 0.05$), which demonstrates no significant difference between pretest and posttest scores in the visual group. This indicates that, under the conditions of this study, visual media alone was not sufficient to produce measurable improvements in student achievement. Therefore, it can be concluded that audio learning media is more effective than visual learning media in enhancing students' learning outcomes in this research context. These findings emphasize that the effectiveness of instructional media is strongly influenced by how well it aligns with learners' cognitive processing characteristics and the nature of the instructional content, highlighting the importance of careful media selection in contemporary pedagogical practice to optimize learning results.

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