



INTERACTIVE VIDEO MEDIA AND STUDENTS' IPAS LEARNING OUTCOMES: A ONE-GROUP PRETEST–POSTTEST STUDY

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Abstract

Interactive video can support the presentation of visually rich learning content by integrating audiovisual information with opportunities for learner interaction. This study examined differences in students' IPAS learning outcomes before and after the use of interactive video media among fourth-grade students at SD Negeri 57 Banda Aceh. A quantitative pre-experimental one-group pretest-posttest design was employed with 27 students. Students' cognitive learning outcomes were measured using a 22-item multiple-choice test that had undergone item validity and reliability testing, with a Cronbach's alpha coefficient of .744. Descriptive statistics were used to summarize pretest and posttest performance, while differences between the paired scores were analyzed using the Wilcoxon Signed-Rank Test because the posttest scores did not meet the stated normality criterion. The mean score increased from 49.556 on the pretest to 86.741 on the posttest. All 27 participants obtained higher posttest scores, with no negative ranks or ties. The Wilcoxon analysis showed a statistically significant difference between pretest and posttest learning outcomes, $Z = -4.544$, $p < .001$. These findings indicate that students demonstrated substantially higher IPAS learning outcomes after instruction supported by interactive video media. Nevertheless, the findings provide context-specific evidence supporting the potential use of interactive video as an instructional medium for visually oriented IPAS content in elementary education and underscore the need for further controlled studies to establish its comparative effectiveness.

Keywords: *Interactive Video; IPAS; Learning Outcomes; Elementary Education; Pretest-Posttest*

A. Introduction

Advances in science and technology have expanded the range of instructional media available to teachers and created new opportunities for presenting learning materials in more interactive and accessible formats. Digital technologies can support changes in instructional delivery by enabling teachers to combine textual, visual, auditory, and interactive elements in the learning process (Mulyani & Haliza, 2021; Haleem et al., 2022). However, the educational value of technology depends not merely on its availability but on how appropriately it is aligned with learning objectives, content characteristics, and learners' cognitive needs. Research on multimedia learning further indicates that the instructional effectiveness of digital media depends substantially on how verbal and visual information is organized and presented (Çeken & Taskin, 2022; Mayer, 2021). Teachers therefore need to select and design instructional media that correspond to both the characteristics of the subject matter and students' learning needs.

Learning outcomes are an important indicator of what students achieve through the learning process and reflect the knowledge and competencies acquired after participation in instructional activities (Ubabuddin, 2019; Nabillah & Abadi, 2019). Learning achievement can be influenced by multiple instructional and learner-related factors, including how learning materials are presented and how effectively instructional activities support students' understanding of the content (Siregar, 2024). In elementary education, this consideration is particularly important because students may encounter difficulties when instructional content is presented primarily through verbal explanation or through media that provide limited support for visualizing concepts. The selection of appropriate instructional strategies and media is therefore an important component of efforts to facilitate students' understanding and improve learning outcomes.

Preliminary observations conducted in Grade IV at SD Negeri 57 Banda Aceh on November 20, 2025, together with an interview with the classroom teacher, indicated several problems in the learning process. Classroom activities tended to be passive, with students primarily listening to the teacher's explanations and showing limited participation. Some students talked with their peers or disturbed classmates during instruction, while students generally showed little response when given opportunities to ask questions. Their learning outcomes in the IPAS subject also indicated that many students had not yet achieved the expected level of mastery. These conditions suggested the need for instructional media that could present the material in a more engaging and accessible format.

Interactive video is an instructional medium that combines audiovisual presentation with opportunities for learners to interact with learning content. Unlike conventional video that primarily presents information for viewing, interactive video may incorporate learner control, embedded questions, prompts, pauses, and other forms of interaction designed to encourage active processing of the material (Palaiageorgiou et al., 2019; Dahlan et al., 2023). Evidence from broader research on instructional video suggests that learning is influenced not simply by the presence of video but by how its content and interactive features are designed. This broader pattern is also reflected in research showing that interactive and video-based learning environments can facilitate instructional delivery and learners' engagement with educational content (Widiya et al., 2021; Sucipto et al., 2022; Noetel et al., 2021). Mayer (2021), for example, emphasized principles such as coherence, signaling, segmenting, and generative activity in effective instructional video design, while Fyfield et al. (2022), in a systematic review of 113 studies, found that instructional videos are more likely to support learning when they are coherent, appropriately segmented, and integrated with learning activities. A meta-analysis by Ploetzner (2022) further showed that educational videos containing enhanced interaction features produced better learning outcomes than videos containing only navigational or no interactive features.

Research in elementary education also provides evidence for the use of video-based and interactive media in science-related learning. Interactive video has been developed for elementary science instruction (Kasturi et al., 2022), while interactive

animated media have been associated with improvements in elementary students' learning outcomes (Pratiwi et al., 2024). Other Indonesian studies have examined interactive video and audiovisual media in elementary science contexts, including interactive video in science learning (Zulfa & Prastowo, 2023), audiovisual media in Grade IV science instruction (Susanti & Apriani, 2020), and video-based science learning at the elementary level (Firman & Bancong, 2024). Research focusing more specifically on IPAS has likewise demonstrated growing use of interactive multimedia in Indonesian elementary schools (Maladerita et al., 2024; Safira & Nahdi, 2024). These studies provide a relevant empirical basis for examining interactive video in the present fourth-grade IPAS context.

In the present study, interactive video was used to present material from Chapter 8, *Becoming an Environmental Hero*, particularly the subtopic *Our Environment Is Under Threat*. The material covered the environment, forms and causes of environmental damage, pollution, its effects on living organisms, and actions that students can take to protect the environment. Against this background, the present study examined students' IPAS learning outcomes before and after the use of interactive video media among fourth-grade students at SD Negeri 57 Banda Aceh. Specifically, the study sought to determine whether there was a statistically significant difference between students' pretest and posttest learning outcomes following the use of interactive video media.

B. Methods

This study employed a quantitative pre-experimental design using a one-group pretest-posttest procedure. The study involved one group of participants who completed a pretest before receiving instruction using interactive video media and subsequently completed a posttest after the intervention. The study was conducted at SD Negeri 57 Banda Aceh, Kopelma Darussalam, Syiah Kuala District, Banda Aceh, Indonesia. The participants were 27 fourth-grade students. Because the design did not include a control group, the analysis focused on examining changes and differences in the participants' learning outcomes before and after the use of interactive video media rather than establishing a controlled causal effect.

Students' cognitive learning outcomes were measured using a written multiple-choice test. The initial instrument consisted of 25 items and was pilot-tested with fifth-grade students outside the study sample who had previously studied the relevant environmental content. Although 27 students were initially involved in the pilot-testing class, 25 were present and provided data for the item analysis. Item validity was examined using Pearson's product-moment correlation at a significance level of .05. Of the 25 items, 22 met the stated validity criterion, whereas items 1, 6, and 24 were excluded from the final instrument. The reliability of the remaining 22 items was assessed using Cronbach's alpha and yielded a coefficient of .744. The final 22-item instrument was then administered to the 27 participants as both the pretest and posttest. For reporting purposes, individual participants were anonymized using the codes S01–S27.

Data analysis was conducted using SPSS. Individual pretest and posttest scores were first summarized descriptively using the total score, mean, minimum, and maximum. The distribution of the pretest and posttest scores was examined using the Shapiro-Wilk test. The pretest scores yielded $p = .130$, whereas the posttest scores yielded $p = .036$. Because the posttest distribution did not meet the stated normality criterion at $\alpha = .05$, the paired pretest and posttest scores were compared using the Wilcoxon Signed-Rank Test. Statistical significance was evaluated using a two-tailed α level of .05; a p -value below .05 was interpreted as evidence of a statistically significant difference between students' learning outcomes before and after the use of interactive video media.

C. Results and Discussion

1. Results

1) Instrument Validity

The initial test instrument consisted of 25 multiple-choice items designed to measure students' cognitive learning outcomes in the IPAS material used in this study. Before the instrument was administered to the study participants, it was pilot-tested with fifth-grade students outside the research sample who had previously studied the relevant environmental content. Although 27 students belonged to the pilot-testing class, 25 students were present and provided data for the item analysis.

Item validity was examined using Pearson's product-moment correlation at a significance level of .05. As shown in Table 1, 22 of the 25 items met the stated validity criterion, whereas three items did not. Items 1, 6, and 24 produced p -values of .071, .058, and .086, respectively, and were therefore classified as invalid based on the criterion applied in the study. The remaining 22 items yielded statistically significant item correlations and were retained for the final test instrument.

Table 1.
Results of the Item Validity Test

Item	Pearson Correlation	p -value	Decision	Interpretation
1	.353	.071	Invalid	Low
2	.397	.040	Valid	Low
3	.408	.034	Valid	Fair
4	.413	.032	Valid	Fair
5	.578	.002	Valid	Fair
6	.370	.058	Invalid	Low
7	.595	.001	Valid	Fair
8	.874	< .001	Valid	Very high
9	.492	.009	Valid	Fair
10	.606	< .001	Valid	High
11	.407	.035	Valid	Fair
12	.421	.029	Valid	Fair
13	.519	.006	Valid	Fair
14	.606	< .001	Valid	High
15	.712	< .001	Valid	High

16	.636	< .001	Valid	High
17	.575	.002	Valid	Fair
18	.606	< .001	Valid	High
19	.851	< .001	Valid	Very high
20	.794	< .001	Valid	High
21	.528	.005	Valid	Fair
22	.604	< .001	Valid	High
23	.694	< .001	Valid	High
24	.336	.086	Invalid	Low
25	.452	.018	Valid	Fair

Source: Authors' instrument testing data, 2025.

The valid items showed Pearson correlation coefficients ranging from .397 to .874. Among them, items 8 and 19 showed the strongest correlations, with coefficients of .874 and .851, respectively. Following the exclusion of the three invalid items, the instrument used for the pretest and posttest consisted of 22 items.

2) Instrument Reliability

After the validity analysis, the internal consistency of the remaining 22 items was examined using Cronbach's alpha. The result is presented in Table 2.

Table 2.
Reliability Statistics

Cronbach's Alpha	Number of Items
.744	22

Source: Authors' instrument testing data, 2025

The analysis yielded a Cronbach's alpha coefficient of .744 for the 22-item instrument. Based on the criterion applied in the study, this coefficient indicated that the instrument had adequate internal consistency and could therefore be used to measure students' learning outcomes in the pretest and posttest.

3) Pretest and Posttest Learning Outcomes

Students' learning outcomes were measured before and after instruction using interactive video media. The pretest was administered before the intervention, while the posttest was administered after the instructional activity. To maintain participant confidentiality, students are identified using codes S01–S27 rather than their names. The paired pretest and posttest scores are presented in Table 3.

Table 3.
Individual Pretest and Posttest Scores

Participant	Pretest	Posttest
S01	72.0	81.0
S02	63.0	76.5
S03	54.0	76.5
S04	22.5	76.5
S05	22.5	81.0
S06	22.5	85.5

S07	19.5	81.0
S08	58.5	90.0
S09	54.0	85.5
S10	18.0	76.5
S11	49.5	81.0
S12	18.0	76.5
S13	54.0	90.0
S14	49.5	94.5
S15	45.0	85.5
S16	58.5	94.5
S17	67.5	90.0
S18	49.5	90.0
S19	85.5	90.0
S20	63.0	81.0
S21	81.0	94.5
S22	67.5	100.0
S23	45.0	90.0
S24	45.0	90.0
S25	45.0	90.0
S26	40.5	100.0
S27	67.5	94.5
Total	1,338.0	2,342.0
Mean	49.556	86.741
Minimum	18.0	76.5
Maximum	85.5	100.0

Source: Authors' research data, 2025

As shown in Table 3, the total pretest score for the 27 participants was 1,338.0, with a mean of 49.556. Pretest scores ranged from 18.0 to 85.5, indicating considerable variation in students' initial learning outcomes before the use of interactive video media.

After the intervention, the total posttest score increased to 2,342.0, with a mean of 86.741. Posttest scores ranged from 76.5 to 100.0. Thus, the mean score increased by approximately 37.19 points from pretest to posttest. The lowest observed score also increased substantially, from 18.0 on the pretest to 76.5 on the posttest, while the highest score increased from 85.5 to 100.0.

The individual paired scores further show that every participant obtained a higher posttest score than pretest score. No participant recorded a lower or identical score after the intervention. The magnitude of the increase varied across participants. For example, students with relatively low initial scores, such as S10 and S12, increased from 18.0 to 76.5, while participants who already had relatively high pretest scores also showed improvement, such as S21, whose score increased from 81.0 to 94.5, and S19, whose score increased from 85.5 to 90.0. Overall, the descriptive pattern indicates a consistent upward shift in learning outcomes across the entire group.

4) Normality Test

Before testing the difference between the paired pretest and posttest scores, the distribution of the data was examined using the Shapiro-Wilk test. The results are presented in Table 4.

Table 4.
Shapiro-Wilk Normality Test

Score	Statistic	df	p-value
Pretest	.941	27	.130
Posttest	.918	27	.036

Source: Authors' data analysis using SPSS, 2025

The pretest scores produced a Shapiro-Wilk statistic of .941 with $p = .130$. Because this value exceeded the .05 significance threshold, the pretest distribution did not significantly depart from normality according to the criterion used in the study. In contrast, the posttest scores produced a Shapiro-Wilk statistic of .918 with $p = .036$. Because this value was below .05, the posttest distribution did not meet the stated normality criterion. On the basis of this result, the comparison between the pretest and posttest scores was conducted using the Wilcoxon Signed-Rank Test as the nonparametric test for paired observations.

5) Wilcoxon Signed-Rank Test

The Wilcoxon Signed-Rank Test was used to determine whether the difference between students' pretest and posttest learning outcomes was statistically significant. The rank distribution is shown in Table 5.

Table 5.
Wilcoxon Signed-Rank Results

Rank	N	Mean Rank	Sum of Ranks
Negative ranks	0	.00	.00
Positive ranks	27	14.00	378.00
Ties	0	—	—
Total	27	—	—

Source: Authors' data analysis using SPSS, 2025

The rank analysis produced 27 positive ranks, no negative ranks, and no ties. The 27 positive ranks indicate that all participants obtained higher posttest scores than pretest scores. The absence of negative ranks indicates that none of the participants experienced a decrease in score, while the absence of ties indicates that no participant obtained the same score on both measurements. The positive ranks had a mean rank of 14.00 and a total rank sum of 378.00. This rank distribution is consistent with the descriptive results presented in Table 3, which showed improvement in the paired scores of all 27 participants. The statistical significance of this difference is presented in Table 6.

Table 6.
Wilcoxon Signed-Rank Test Statistics

Comparison	Z	p-value (two-tailed)
Posttest–Pretest	–4.544	< .001

Source: Authors' data analysis using SPSS, 2025

The Wilcoxon Signed-Rank Test yielded $Z = -4.544$ with a two-tailed p -value of $< .001$. Because the p -value was below the predetermined significance level of $.05$, the null hypothesis was rejected. Therefore, the difference between students' pretest and posttest IPAS learning outcomes was statistically significant.

Taken together, the descriptive and inferential results show a consistent pattern. The mean learning outcome increased from 49.556 before the intervention to 86.741 after the intervention, all 27 participants obtained higher posttest scores, and the Wilcoxon Signed-Rank Test confirmed that the observed pretest-posttest difference was statistically significant. These findings provide the empirical basis for addressing the research objective concerning differences in students' learning outcomes before and after the use of interactive video media.

2. Discussion

The findings indicate a clear improvement in students' IPAS learning outcomes between the measurements conducted before and after the use of interactive video media. The mean score increased from 49.556 on the pretest to 86.741 on the posttest, representing an increase of approximately 37.19 points. This pattern was not limited to the group average: all 27 participants obtained higher posttest scores than pretest scores, with no negative ranks or ties. The Wilcoxon Signed-Rank Test further confirmed that the difference was statistically significant, $Z = -4.544$, $p < .001$. Taken together, these results indicate that students demonstrated substantially higher learning outcomes after participating in instruction supported by interactive video media.

The observed pattern is consistent with previous research examining video-based and interactive media in elementary science learning. Karo-Karo et al. (2024), for example, reported higher science learning outcomes among fifth-grade elementary students following instruction using interactive video media. The methodological context of that study is particularly relevant because it also employed a pre-experimental one-group pretest-posttest design. Comparable patterns have been reported in other elementary science and IPAS contexts. Interactive animated video oriented toward a contextual approach has been associated with improved IPAS learning outcomes among elementary students (Lippi et al., 2025), while animated video developed for fourth-grade IPAS instruction was followed by substantial improvement between pretest and posttest performance (Imamah et al., 2025). Research using interactive multimedia in primary science has similarly reported higher achievement following multimedia-supported instruction (Mostafa et al., 2024). At a broader level, a systematic review of animated-video use in primary science found a generally positive pattern in students' learning outcomes across the studies reviewed (Angelika et al., 2025). Related evidence from elementary science and video-based learning likewise reports positive learning patterns across different video formats and instructional contexts (Findeisen et al., 2019; Musfiza et al., 2025; Prayoga et al., 2025). These studies place the present findings within a broader pattern of improved learning performance following video- or multimedia-supported elementary science instruction. Nevertheless, differences in design, content,

and intervention characteristics mean that these findings should not be interpreted as evidence that all forms of interactive video necessarily produce the same effect.

The improvement observed in the present study may also be considered in relation to the instructional characteristics of interactive video. Interactive video can combine verbal and visual information while providing opportunities for learners to respond to prompts or interact with the instructional sequence. From a multimedia-learning perspective, such combinations can support learning when visual and verbal information are meaningfully coordinated and unnecessary cognitive processing is minimized (Mayer, 2021; Çeken & Taskin, 2022). Systematic evidence on instructional-video design likewise indicates that coherence, segmentation, learner control, and integration with learning activities are among the design characteristics associated with better learning outcomes (Fyfield et al., 2022).

The interactive component may also be important. Ploetzner's (2022) meta-analysis found that educational videos containing enhanced interaction features were more effective for learning than videos containing only navigational interaction or no enhanced interaction features. This provides a plausible instructional explanation for why video that requires learners to respond to content may differ from passive video viewing. Kasturi et al. (2022) similarly demonstrated the applicability of interactive video in elementary science instruction. In the present study, these characteristics were particularly relevant because the learning material addressed environmental damage, pollution, their effects on living organisms, and environmental protection—topics that lend themselves to visual and contextual representation. However, the present study did not experimentally isolate individual video-design features; therefore, it cannot determine which specific component of the interactive video contributed to the observed score improvement.

This interpretation is also compatible with the descriptive pattern in the data. Students entered the intervention with markedly different levels of achievement, as reflected in pretest scores ranging from 18.0 to 85.5. Following the instructional intervention, the range shifted upward to 76.5–100.0. The improvement was therefore evident not only among students with relatively low initial scores but also among students who had already performed comparatively well on the pretest. This suggests that the instructional activity was followed by improvement across different levels of initial achievement within the group. Nevertheless, because the study did not investigate the mechanisms responsible for this change, the results cannot establish whether the improvement was specifically produced by greater attention, motivation, engagement, retention, or other psychological processes.

The distinction between measured outcomes and possible instructional mechanisms is important when interpreting these findings. The instrument used in this study assessed cognitive learning outcomes through a multiple-choice test. Consequently, the present data directly support conclusions concerning changes in learning outcomes, but they do not directly demonstrate changes in students' motivation, engagement, critical thinking, enthusiasm, or long-term retention. Previous studies have associated interactive

or multimedia-supported instruction with learner participation, engagement, and other learning-related processes (Dahlan et al., 2023; Sihotang et al., 2025; Zulfa & Prastowo, 2023). However, these constructs were not measured in the present study and should therefore be treated only as possible explanatory mechanisms rather than as empirical findings. Further research would need to employ dedicated measures of motivation, engagement, critical thinking, or retention before determining whether these factors accompany or mediate changes in learning outcomes.

The nature of the IPAS material also provides a relevant pedagogical context for the use of interactive video. The intervention addressed environmental conditions, forms and causes of environmental damage, pollution, its effects on living organisms, and actions for environmental protection. Such content includes processes, conditions, and relationships that can be represented visually rather than explained exclusively through verbal description. Previous research on elementary science and IPAS has similarly emphasized the value of interactive multimedia and video-based representations for presenting science content in accessible and contextual formats (Maladerita et al., 2024; Safira & Nahdi, 2024; Firman & Bancong, 2024). This is consistent with multimedia-learning research indicating that appropriately coordinated visual and verbal representations can support comprehension (Mayer, 2021). Nevertheless, because the present study did not compare interactive video with another instructional medium or with conventional instruction in a control group, the data cannot establish whether interactive video was superior to alternative instructional approaches.

The findings therefore need to be interpreted within the limits of the research design. The one-group pretest-posttest design establishes that students' scores were significantly higher after the intervention, but it does not fully rule out alternative explanations for the observed change. Without a control group, factors such as familiarity with the test, exposure to the instructional material, classroom experiences occurring between the two measurements, or other uncontrolled influences may also have contributed to the improvement. The use of the same instrument for the pretest and posttest further means that repeated exposure to the test items cannot be completely separated from the instructional effect. Accordingly, the present findings are better interpreted as evidence of a significant pretest-posttest improvement associated with the instructional period in which interactive video was used, rather than definitive proof that interactive video alone caused the observed increase.

D. Conclusion

The study found a statistically significant difference between students' IPAS learning outcomes before and after the use of interactive video media among fourth-grade students at SD Negeri 57 Banda Aceh. The mean score increased from 49.556 on the pretest to 86.741 on the posttest, and all 27 participants obtained higher posttest scores. The Wilcoxon Signed-Rank Test confirmed that the difference was statistically significant, $Z = -4.544$, $p < .001$. These findings indicate that students demonstrated substantially higher learning outcomes after participating in instruction supported by

interactive video media. The findings should be interpreted within the limitations of the one-group pretest-posttest design. Because the study did not include a control group, the observed improvement cannot be attributed exclusively to interactive video media. Future research should employ stronger experimental or quasi-experimental designs, include comparison groups, document the instructional intervention in greater detail, and examine additional learning-related outcomes using appropriate measurement instruments.

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