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THE EFFECT OF INTERACTIVE LEARNING VIDEOS ON INFORMATICS LEARNING OUTCOMES: A QUASI-EXPERIMENTAL STUDY WITH JUNIOR HIGH SCHOOL STUDENTS

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Abstract

This study was conducted to determine the effectiveness of interactive learning videos on junior high school students' Informatics learning outcomes in computational thinking material in terms of gender. The research employed an experimental method with a nonequivalent control group design. The results showed that prior to the treatment, the initial abilities of both groups were relatively similar, with the mean pretest scores of the experimental group at 45.17 and the control group at 45.71. After the treatment, both groups showed an increase in learning outcomes; however, the experimental group achieved a higher mean score of 83.61 compared to 73.05 in the control group. The ANCOVA results indicated a significant difference between the two groups after controlling for prior knowledge ($p < 0.001$), while gender did not have a significant effect on learning outcomes ($p > 0.05$), and no interaction was found between instructional model and gender. Based on these findings, it can be concluded that interactive learning videos are effective in improving students' Informatics learning outcomes in computational thinking and can be applied consistently regardless of students' gender.

Keywords: interactive learning videos, Informatics education, computational thinking, learning outcomes, gender.

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INTRODUCTION

The swift advancement of digital technology has induced substantial transformations in all facets of life, particularly in education. Numerous technological advancements, including the use of artificial intelligence (AI), the Internet of Things (IoT), big data, and automated systems, offer new problems and opportunities necessitating humans to possess the capacity to adapt and engage effectively in the digital age. Digital skills, information handling, and ability to solve problems are essential competences for the 21st century that should be cultivated through education in order to prepare students for the challenges of an increasingly technologically savvy society and workforce

(Luengo-Aravena et al., 2024; OECD, 2024). Consequently, digital competence is a fundamental skill that students must acquire to engage effectively in a knowledge and technology-driven society by accessing, managing, evaluating, and utilising information responsibly (Zhong & Juwaheer, 2024). Moreover, proficiency in digital skills not only enhances educational achievements but also significantly contributes to productivity, innovation, employability, and personal competitiveness in the context of digital transformation (Antonijević et al., 2023). Therefore, cultivating information technology skills is essential for equipping the younger generation to confront issues in the digital age.

In Indonesian education, the advancement of digital competences, information processing, and problem-solving abilities is promoted through Informatics courses at the primary and secondary school stages. The Ministry of Education, Culture, Research, and Technology, through Permendikbudristek Number 12 of 2024 describing the Curriculum for Early Childhood Education, Elementary Education, and Secondary Education, states that Informatics areas of study are intended to foster students' computational thinking skills, digital literacy, proficiency in information and communication technology, and the capacity to solve problems logically, critically, creatively, and responsibly (Menteri Pendidikan, Kebudayaan, Riset, 2024). Informatics education strives for students to become not only capable consumers of technology but also to comprehend computer principles and use them when confronting diverse real-world challenges.

Informatics education can be carried out through plugged and unplugged procedures. Plugged procedures employ digital tools and equipment, whereas unplugged procedures demonstrate informatics concepts without technological assistance. Numerous research have demonstrated that both procedures are beneficial in cultivating students' computational thinking and problem-solving abilities. Well-designed learning activities utilising both plugged and unplugged methodologies have demonstrated enhancements in students' conceptual comprehension, computational thinking capabilities, and problem-solving skills (Chen et al., 2023; Montuori et al., 2024). For this reason, the incorporation of both procedures has been shown to enhance students' logical and structured reasoning abilities as well as their problem-solving skills.

The implementation of informatics studies at the level of junior high schools encounters numerous hurdles that may affect students' performance in terms of learning outcomes. A frequent issue is that student learning outcomes remain insufficient, particularly in abstract subjects such as computational thinking, algorithms, visualisation of data, and programming fundamentals. The acquisition of computational thinking skills is obstructed by insufficient student motivation and engagement, restricted interactive learning resources, and disparate levels of instructor preparedness in incorporating technology into the educational process (Monemnasi et al., 2026). In Furthermore, numerous students commence their Informatics education lacking adequate experience or core skills in Computer Science and Computational Thinking, resulting in challenges in conceptualising abstract concepts such as algorithms, data visualisation, and software programming (Cafarella & Vasconcelos, 2024). The task is becoming more intricate since Informatics education necessitates abstract thought, logical thought processes, and capacity for problem-solving as fundamental elements of computational thinking (Pan et al., 2024). These challenges might impede conceptual comprehension and adversely affect student performance in Informatics courses..

To resolve these issues, innovative instructional techniques are required to facilitate students' comprehension of informatics subjects in a more tangible and engaging approach. An effective approach involves utilising learning resources that align with the material's features and the students' needs. Educational media serves as a mechanism that aids students in visualising abstract topics, enhances learning engagement, and promotes a more dynamic educational experience. Studies indicate that well-designed educational media can enhance learning motivation, conceptual comprehension, and student performance (Kaifeng & Pengbo, 2024). Other research indicate that the use of video in education positively influences student learning outcomes in comparison to traditional or non-video learning methods (Noetel et al., 2021). Consequently, the use of educational media, particularly instructional videos, serves as an option to enhance Informatics education and facilitate students' comprehension of computing ideas more effectively.

Instructional video is a medium that can enhance Informatics learning. Instructional videos primarily convey content through a synthesis of visual and auditory components, facilitating a more accessible and engaging comprehension of knowledge for students. In Informatics education, instructional movies serve to illustrate abstract concepts, systematically elucidate problem-solving methodologies, and demonstrate software applications or programming procedures that are challenging to witness directly. Numerous studies indicate that instructional videos enhance conceptual comprehension, learning engagement, and student performance relative to traditional lectures or conventional teaching resources (Fyfield et al., 2022; Rambari Apandi et al., 2024; Setyawan et al., 2024).

The advancement of digital technology has facilitated the evolution of learning videos from passive to interactive media. Interactive learning videos enable students to engage with the content by participating in quizzes, answering questions, navigating materials, and receiving integrated feedback. These attributes allow pupils the opportunity to actively participate in the learning process and independently create understanding. Interactive learning videos enhance material delivery while simultaneously augmenting student engagement and motivation through active participation in the learning process. Numerous studies indicate that interactive learning videos or those incorporating active learning strategies are more effective in enhancing student engagement, information retention, and conceptual understanding compared to passive learning videos (Dahlan et al., 2023; Deng et al., 2025; Zhang et al., 2025). Moreover, interactive learning videos or those incorporating active learning strategies, as evidenced by various studies, positively impact learning activities, motivation, conceptual comprehension, and student outcomes by enhancing engagement and active information processing during the learning process (Dahlan et al., 2023; Deng et al., 2025; Noetel et al., 2021; Ploetzner, 2024; Zhang et al., 2025). Consequently, interactive learning videos can serve as an efficient alternative medium to enhance Informatics education.

Despite numerous studies indicating that learning videos and interactive films enhance the quality of educational processes and outcomes, research on interactive learning videos in Informatics and computational thinking abilities at the junior high school level remains comparatively scarce. This study aimed to design and evaluate the efficacy of interactive learning films in enhancing student learning outcomes in Informatics at the junior high school level.

METHOD

The research investigated the efficacy of interactive learning videos on informatics learning outcomes among junior high school students, employing a quasi-experimental method with a non-equivalent control group design. This approach was selected due to constraints in completely randomising individuals, however it facilitated the inclusion of a control group for comparative analysis of variations in learning outcomes. The research was carried out at Harapan Ananda Kuburaya Junior High School, involving 83 students: 41 from grade VII A and 42 from grade VII B. The sample was chosen by a saturated sampling strategy, employing the entire population as research subjects.

Data were acquired via interviews, assessments, and documentation. Interviews were conducted to collect preliminary data on the implementation of informatics education, the utilisation of instructional media, and the motivation levels of students. Assessments were employed to evaluate student learning results before to and following the intervention, while documentation provided supplementary data, encompassing school profiles, student information, and educational activities. The indicators used to develop the assessment questions are presented in Table 1.

Table 1. Tes Question Indicators

No	Learning Objectives	Indicator	Question Type
1.	Students are able to apply computational thinking to efficiently solve computational problems containing algorithms, data representation, data structures (lists), and scheduling.	Students are able to apply computational thinking to efficiently solve computational problems involving algorithms.	C1 C2 C3
		Students are able to apply computational thinking to efficiently solve computational problems involving optimization.	C1 C2 C3
2.	Students can relate the application of Informatics concepts contained in each question in everyday life.	Students are able to apply computational thinking to efficiently solve computational problems that contain data structures.	C1 C2 C3
		Students are able to apply computational thinking to efficiently solve computational problems that contain data representation.	C1 C2 C3

The test instrument underwent validity testing to confirm the test questions prior to utilisation. The employed validity assessments were conceptual validity and empirical validity. Construct validity is an evaluation performed via expert assessment and item correlation analysis relative to the overall score to ascertain the appropriateness of the instrument, which has been previously validated by experts. Empirical validity is an assessment conducted to determine the validity of test items by assessing the correlation between item scores and the total score (Fadli et al., 2023).

The research employs descriptive statistics as a data analysis technique to illustrate student informatics learning outcomes. The subsequent step involves evaluating the efficacy of interactive learning videos on student results in Informatics by analysis of covariance (ANCOVA), utilising pretest scores as a covariate and a significant threshold of 0.05.

RESULTS AND DISCUSSION

Interactive learning films were provided to junior high school students to assess the efficacy of these movies in informatics lessons focused on computational thinking, with consideration of student gender. Interactive learning videos are audiovisual media that incorporate multimedia elements and interactive features to enhance the learning process, thereby augmenting student engagement and comprehension of informatics content, which has implications for improving educational outcomes (Navarrete et al., 2025). The research was performed on eighth-grade students at Harapan Ananda Middle School with a nonequivalent control group design. The examination of students' preliminary competencies in computational thinking, as indicated by pretest scores, demonstrated no disparities in first ability. The experimental group exhibited an average score of 45.17 with a standard deviation of 9.09, while the control group demonstrated an average score of 45.71 with a standard deviation of 7.08. Following the therapy, the experimental class achieved an average posttest score of 83.61 with a standard deviation of 6.68, while the control class attained a score of 73.05 with a standard deviation of 9.18. This signifies a disparity in educational outcomes between students who utilised interactive learning films and those who engaged in traditional learning methods. Figure 1 displays the pretest and posttest scores.

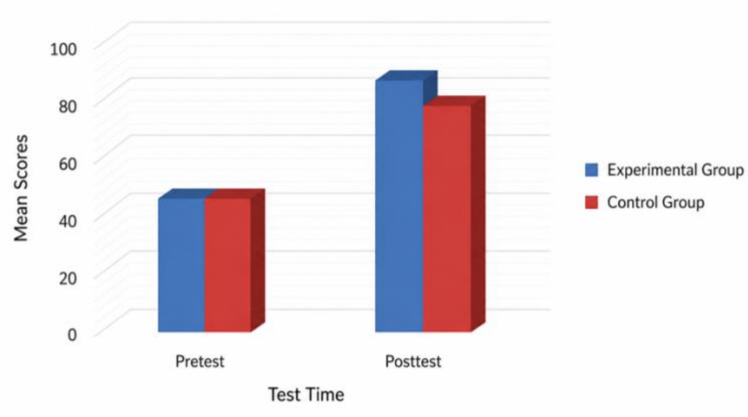

Figure 1. Histogram of Distribution Pretest and Posttest

Figure 1 indicates that the mean posttest score of students in the experimental group surpassed that of the control group. This suggests that interactive learning films enhance students' comprehension of computational thinking, leading to superior learning results compared to traditional instructional methods. Interactive learning films enhance students' active participation in the educational process, hence facilitating a deeper comprehension of computational thinking concepts and influencing academic outcomes (Deng et al., 2025; Ploetzner, 2024).

Computational thinking is a crucial competency in Informatics disciplines, emphasising the capacity to solve issues logically, systematically, and efficiently. This capability has four primary elements: breakdown, pattern recognition, abstraction, and algorithms, which are interconnected in the problem-solving process (Nukman & Setyowati, 2023). Students must not only comprehend these principles but also apply them in diverse settings and challenges they encounter (Ezeamuzie & Leung, 2022). This intricacy renders computational thinking particularly tough for students. Challenges frequently faced encompass pinpointing the essence of the issue, discerning pertinent patterns, distilling critical information, and formulating organised stages for resolution (Junaeti et al., 2025). Consequently, there is a want for educational media that can facilitate students' comprehension of computational thinking principles in a more tangible and accessible manner. Interactive learning films serve as an alternative that can facilitate this process by delivering content through a synthesis of visuals, audio, and interactive activities, hence enhancing student involvement in learning (Deng et al., 2025; Mayer, 2024; Truss et al., 2024).

A normality test was subsequently conducted as a prerequisite for hypothesis testing, which is essential for ascertaining the data distribution. Data may be utilised if they have a normal distribution, as shown by a significance value exceeding 0.05. The outcomes of the normality test are presented in Table 2, while the distribution pattern is illustrated in Figure 2.

Table 2. Normality Test Results

Normality Test	Statistic	df	Sig.	Decision
Kolmogorov-Smirnov	0,091	83	0,086	Normal
Shapiro-Wilk	0,990	83	0,756	Normal

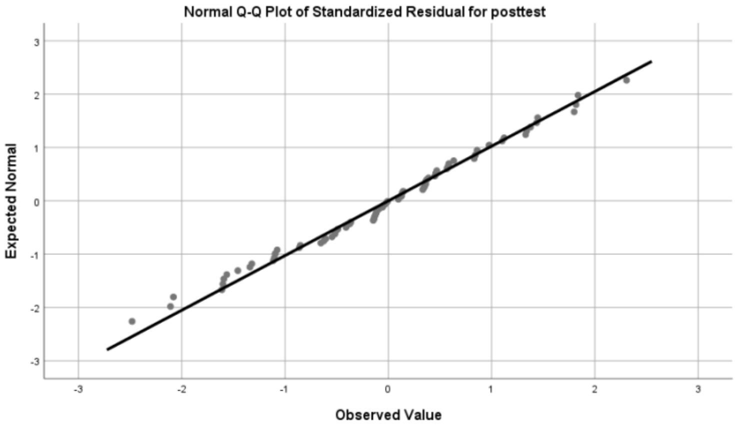

Figure 2. Distribution of Normality Patterns

A residual normality assessment was conducted on the standardised residuals derived from the ANCOVA model. The Shapiro-Wilk test yielded a significance score of 0.756, exceeding 0.05. Moreover, the pattern in the Normal Q-Q Plot suggests that the residual points generally align with the diagonal line. Consequently, it can be inferred that the residuals have a normal distribution, so satisfying the condition of normality.

The homogeneity of variance test is performed to assess the equivalence of variance among data groups, serving as a requirement for hypothesis testing. The homogeneity test yielded a $F(3,79)$ statistic of 1.718 and a p-value of 0.170. The results indicate that the posttest variance among groups is homogeneous, as the p-value exceeds 0.05. The outcomes of the homogeneity of variance test are presented in Table 3.

Table 3. Results of The Homogeneity of Variance Test

F	df1	df2	Sig.
1,718	3	79	0,170

Once the data satisfies the assumptions of normality and homogeneity of variance, the homogeneity of regression slopes test is conducted as a prerequisite for analysis of covariance (ANCOVA). This test seeks to assess the congruence of the regression line slopes among the groups under comparison. The outcomes of the homogeneity of regression slopes test are presented in Table 4.

Table 4. Results of The Homogenity of Regression Slopes Test

Tested Effect	Sig.	Decision
Group × Pretest	0,895	Not Significant
Gender × Pretest	0,122	Not Significant
Group × Gender × Pretest	0,374	Not Significant

A homogeneity of regression slopes test was performed to ascertain if the connection between pretest and posttest scores varied by groups and genders. The analysis indicated that the interaction between the group and pretest was not significant, $F(1,75) = 0.017$, $p = 0.895$. The interaction between gender and pretest was not significant, $F(1,75) = 2.452$, $p = 0.122$. The interaction among group, gender, and pretest was not significant, $F(1,75) = 0.798$, $p = 0.374$. Consequently, the assumption of uniformity in regression slopes was satisfied.

Subsequently, following the completion of all essential analytical procedures, including assessments of normality, variance homogeneity, and regression slope homogeneity, an analysis of covariance (ANCOVA) was performed. This investigation aimed to assess the impact of interactive learning videos on student learning outcomes while accounting for variations in baseline ability as shown by pretest scores. Consequently, variations in posttest scores may be assessed with greater precision as they consider the impact of students' baseline competencies. The findings of the ANCOVA analysis are displayed in Table 5.

Table 5. Results of ANCOVA Test

Source	F	Sig.	Partial Eta Squared	Conclusion
Group	34,451	0,000	0,306	Significant
Gender	0,068	0,795	0,001	Not Significant
Pretest	0,027	0,869	0,000	Not Significant
Group × Gender	0,092	0,763	0,001	Not Significant

The ANCOVA analysis revealed a significant difference in posttest scores between the experimental and control groups after controlling for pretest scores, with $F(1,79) = 34.451$ and $p < 0.001$. This discovery demonstrates that interactive learning videos substantially affect students' Informatics learning results. The treatment's contribution is quantified by a Partial Eta Squared value of 0.306, signifying that roughly 30.6% of the variance in posttest scores is attributable to variations in learning treatments, with the remainder affected by extraneous factors beyond the research model. This finding aligns with the principle of interactivity in multimedia learning, indicating that granting learners control can affect their cognitive processes, especially in alleviating cognitive load, though its effect on enhancing learning outcomes is not consistently observed across different learning contexts (Dusanek & Kollar, 2025). In the realm of Informatics education, interactive multimedia generates varied learning experiences based on student capabilities, resulting in increased self-efficacy among high-ability students and less learning saturation overall (Firdaus et al., 2023).

Moreover, the study results showed no significant difference in posttest scores between male and female students after controlling for pretest scores ($F = 0.068$; $p = 0.795$). Additionally, the pretest scores as a covariate did not substantially contribute to posttest scores ($F = 0.027$; $p = 0.869$), and there was no significant interaction between learning group and gender ($F = 0.092$; $p = 0.763$) . These results suggest the effectiveness of interactive learning videos to improve learning outcomes is consistent for both male and female students, and it is not influenced by differences in the baseline skills of students after the therapy is delivered (Heo & Toomey, 2020).

A pairwise comparisons study was performed to get a more complete view of the differences in average learning outcomes between groups after the influence of variables was controlled. The results of this study provide information on pairings of groups that demonstrate statistically significant differences. Table 6 presents the full results of the Pairwise Comparisons investigation.

Table 6. Results of Pairwise Comparisons Test

Comparison	Mean Difference	Sig.
Experimental – Control	10,566	0,000

Pairwise comparison analysis showed that after correcting for the effect of pretest scores, there was a significant difference between the experimental and control groups. The average posttest score of the experimental group was 10.566 higher than that of the control group with a significance value of 0.000 ($p < 0.05$). The results show that the usage of interactive learning films has a positive effect on the learning outcomes of students in the content of computational thinking. The improvement in learning outcome implies that interactive learning video can optimise the process of comprehending concept, particularly for abstract and procedural information in computational thinking. This finding is consistent with earlier studies that suggest interactive learning films can enhance learning outcomes through active cognitive engagement of students with the help of generative activities and an adequate learning framework (Fiorella, 2021; Griffith et al., 2021).

The success of learning videos can be explained by the integration of several information representations in interactive movies such as text, graphics, audio, animation, and interactive activities that promote the learning process. The substance of computational thinking is visualisation and simulation. It helps students to learn the processes of systematic problem solution starting with decomposition, pattern recognition, abstraction to algorithms. Additionally, the flexibility of asynchronous learning videos allows students to review content, perhaps allowing for increased understanding and mastery of concepts more effectively (Griffith et al., 2021).

In addition, the study results also demonstrate that the average posttest score of the experimental group is greater than the control group for male and female students, with very modest differences. An summary of these data is shown in Figure 3.

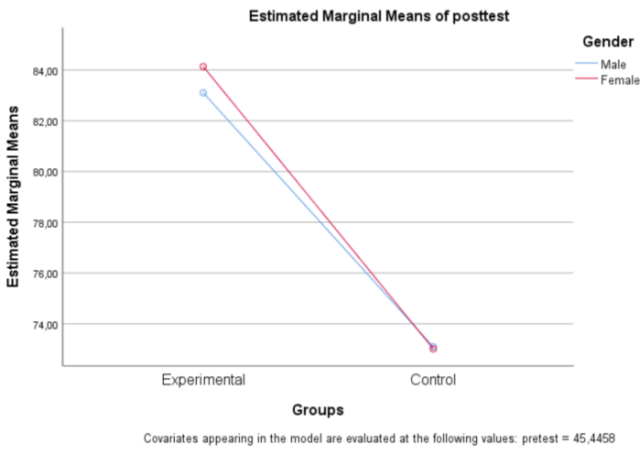

Figure 3. Trend of Results Based on Gender

As shown in Figure 3, the experimental group had a higher mean posttest score than the control group for both male and female students. The insignificant difference between male and female test scores indicated that interactive learning videos had an equal impact in terms of the improvement of learning outcomes for both genders. For this reason, the variations in learning outcomes revealed were more strongly influenced by the learning intervention than by the student gender.

These findings are consistent with meta-analyses indicating that technology-based learning provides essentially equal learning chances for male and female students, since no significant gender disparities were detected in learning performance (Yu & Deng, 2022). Furthermore, other studies also report that the gender differences in multimedia learning do not lead to any significant differences in learning outcomes, either in terms of retention or knowledge transfer, such that the effectiveness of multimedia learning is more dependent on the quality of the learning design and the characteristics of the media used than gender factors (Zhao et al., 2025). This is supported by the fact that gender attributes in learning videos do not significantly influence the improvement of student learning results, so the effectiveness of video-based learning is more determined by the quality of material presentation and the instructional design used (Schrader et al., 2021).

CONCLUSION

This research reveals that interactive learning films can improve the learning results of junior high school pupils in Informatics in computational thinking. Results of the ANCOVA analysis indicated a significant difference between the experimental and control groups after correcting for beginning ability, with the experimental group having higher learning outcomes. Additionally, there were no significant changes depending on gender and no interaction between learning model and gender was discovered, therefore, the effectiveness of the learning media was the same for male and female students. The interactive learning video is appropriate to be used as an alternative Informatics learning media, especially for abstract and procedural elements like as computational thinking. This media assists teachers to deliver the subject in a more easily fascinating way and it boosts students' enthusiasm in learning. However, the development of it can be improved mainly in the features of interactivity, change of information, and practice and feedback to optimise student understanding. In general this interactive learning movie is useful and appropriate to be used in learning Informatics at the junior high school level.

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