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The effect of using animaker-based audiovisual media on students' mathematical literacy skills

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Abstract

This research addresses the low level of students' mathematical literacy, as evidenced by the 2022 PISA results and a preliminary survey conducted at SMA Negeri 5 Metro. The study aimed to evaluate the impact of Animaker-based audiovisual media on the mathematical literacy of tenth-grade students, specifically regarding measures of central tendency and data distribution. Utilizing a quantitative, quasi-experimental approach with a post-test-only control group design, the study sampled 70 students from the total population of 286 tenth-graders across eight classes. Participants were selected via cluster random sampling, with class X7 assigned to the experimental group and class X5 to the control group. Data were analyzed using the Shapiro–Wilk normality test, Levene's homogeneity test, and the Mann–Whitney U test. The findings revealed that the mean score of the experimental group (74.86) was significantly higher than that of the control group (50.38), with a significance value of $p < 0.05$. Furthermore, an effect size of 0.96 confirms a substantial practical impact of the intervention. These findings indicate that students taught with Animaker-based audiovisual media achieved significantly higher mathematical literacy scores than those in conventional instruction, suggesting that this media is a promising alternative for mathematics learning.

Keywords: Animaker; Animated Video; Learning Media; Mathematical Literacy.

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INTRODUCTION

Mathematical literacy is considered a vital competency in mathematics education, as it enables students to formulate, apply, and interpret mathematical concepts across a wide range of real-world contexts (OECD, 2023). Beyond procedural knowledge, mathematical literacy equips students to reason, solve problems, communicate mathematical ideas, and make informed decisions in everyday situations. These competencies are also aligned with the goals of mathematics learning proposed by the National Council of Teachers of Mathematics (NCTM), which emphasize problem solving, reasoning, communication, representation, and mathematical connections (NCTM, 2016).

Despite its importance, Indonesian students continue to demonstrate low levels of

mathematical literacy. According to the 2022 PISA results, Indonesian students' mathematics literacy scores remain very low. Only about 18% of students met the basic proficiency standard (Level 2), a figure that lags far behind the OECD average of 69%. This situation is exacerbated by the near absence of Indonesian students capable of attaining high proficiency levels (Levels 5 or 6), even though the global average is 9%. This fact provides clear evidence that students' mathematics proficiency in Indonesia generally falls short of expectations (OECD*,* 2023).

This national issue is consistent with the results of a preliminary survey conducted at SMA Negeri 5 Metro. A preliminary assessment involving 29 tenth-grade students was conducted using three validated mathematical literacy test items adapted from I'tishambillah (2023). The test focused on the topics of measures of central tendency and data dispersion and assessed the three mathematical literacy processes proposed formulating situations mathematically, employing mathematical concepts, facts, procedures, and reasoning, and interpreting, applying, and evaluating mathematical outcomes. The adapted instrument had previously undergone validity testing and was therefore considered suitable for measuring students' mathematical literacy.

Students' scores were classified into three levels based on predetermined score intervals: high (score ≥ 77), medium ($56 \leq \text{score} < 77$) and low (score < 56). The results showed that 28 students (97%) were categorized as having low mathematical literacy, only one student (3%) reached the medium category, and none achieved the high category (Maryatun et al., 2025). These findings indicate that most students experienced difficulties not only in performing statistical calculations but also in formulating mathematically meaningful contextual problems and interpreting the meaning of their solutions. The categorization of students' mathematical literacy levels is presented in Table 1.

Table 1. Mathematical Literacy Skills Category

Category	Number of Students
High	0
Medium	1
Low	28

Table 1 above shows that of the total 29 student respondents, 28 students (97%) remain in the low proficiency category, while only 1 student (3%) falls into the medium category, and none have reached the high category. Classroom observations further revealed that students experienced considerable difficulty solving contextual statistical problems, particularly those involving measures of central tendency and data dispersion. Many students were able to perform calculations mechanically but struggled to formulate mathematical models from

context and to interpret the meaning of their results. These findings indicate that mathematics instruction remains focused primarily on procedural knowledge rather than on developing higher-order mathematical literacy skills (Pertiwi et al., 2020).

One factor contributing to this problem is the limited use of learning media that effectively visualize abstract statistical concepts in meaningful contexts. Learning media play an important role in increasing students' attention, motivation, and conceptual understanding by presenting information in more engaging and memorable ways (Habiba Ulfahyana, 2024). In particular, audiovisual media have been shown to facilitate mathematics learning by integrating visual representations with verbal explanations, making learning more interactive and meaningful Darwata & Handican (2023).

A preliminary needs analysis conducted at SMA Negeri 5 Metro further confirmed the need to develop audiovisual learning media. Interviews with mathematics teachers revealed that classroom instruction on measures of central tendency and data dispersion primarily relied on textbooks, PowerPoint presentations, and conventional explanations. Existing learning media were found insufficient to illustrate statistical concepts in real-world contexts, leading students to have difficulty understanding the meaning of statistical measures beyond procedural calculations. In addition, student questionnaires indicated that they preferred learning materials presented through animated videos with contextual examples because such media were perceived as more engaging, easier to understand, and accessible for independent learning outside the classroom. These findings demonstrate a clear need for contextually rich audiovisual learning media that support students' mathematical literacy development.

One audiovisual platform with considerable potential for mathematics learning is Animaker. Animaker enables teachers to create animated instructional videos featuring dynamic characters, narration, transitions, and contextual learning scenarios to explain abstract concepts more clearly (Kamalia & Rahmadhar, 2023). Moreover, the videos can be shared through online links, allowing students to revisit learning materials independently outside classroom hours (Situmorang et al., 2023). This gives them the flexibility to review the material outside of school hours, whether at home or elsewhere, to deepen their understanding of the concepts covered.

The advantages of audiovisual media, particularly Animaker, have been supported by research findings demonstrating its practicality and effectiveness in improving students' mathematical literacy. In fact, research data indicate that this application receives high ratings for its contribution to the development of these mathematical skills (Kustriani et al., 2023).

Similar findings were reported by other researchers, who showed that the use of audiovisual media applications, such as VideoScribe by Sparkol, had a significant impact on students' literacy development. Data revealed a significant improvement from the beginning to the end of the learning process, thereby confirming that this method is highly appropriate and effective for implementation in mathematics instruction (Ningrum, 2022). A similar view was expressed by Hamdia et al. (2025), through their research utilizing the Benime application. The data indicate that animated videos have been shown to significantly improve students' mathematical literacy. Thus, the application of animated media, whether through the Animaker, VideoScribe, or Benime platforms, has proven highly promising and effective for enhancing mastery of mathematical literacy.

To date, there has been relatively little scientific research specifically addressing the use of Animaker for teaching data central tendency and dispersion in 10th-grade high school classes. A similar trend is evident in mathematical literacy assessment indicators, which have not yet comprehensively measured the Formulate, Employ, and Interpret aspects. Therefore, this study aims to fill this gap by introducing self-developed media and contextually designed questions. The objective is to obtain clear empirical evidence of the impact of this media on students' mathematical literacy.

METHODS

This study employs a quantitative, quasi-experimental design. This design was adopted to analyze the causal relationships among the variables under study. Unlike a pure experimental design, this method does not employ a completely random sample selection. This allows the researcher to conduct observations under real-world conditions without compromising the validity of the resulting data (Anantasia & Rindrayani, 2025).

A quasi-experimental design is considered the most appropriate because it adapts to the existing situation. In practice, researchers often cannot control all influencing factors, nor can they completely randomize subjects. Through this approach, researchers can still apply a specific treatment to the experimental group and compare the results with those of the control group. This allows for the identification of differences in outcomes or effects, thereby creating a good balance between the strict control of the research and the actual learning conditions that occur in schools.

The design applied in this study is the Post-test Only Control Group Design. This model is a quasi-experimental design used to analyze the impact of Animaker media on students'

levels of mathematical literacy. This study involved two groups of subjects: the first received special treatment through learning with Animaker media, while the other group followed a conventional learning process without such media. After all learning stages were completed, both groups took a post-test to assess learning outcomes and compare levels of mathematical literacy. The design of this study is shown in the Table 2.

Table 2. Post-test Only Control Group Design

Group	Treatment	Post-Test
Experimental (E)	X	0_1
Control (K)	Y	0_2

Notes:
X : Learning using Animaker-based audiovisual media.
Y : Conventional learning (without Animaker-based audiovisual media).
0_1 : Post-test scores for mathematical literacy in the experimental class.
0_2 : Post-test scores for mathematical literacy in the control class.

In this study, the population consisted of 286 tenth-grade students across eight classes at SMAN 5 Metro (2025/2026 academic year). To ensure representative sampling, a cluster-random sampling technique was used, in which entire classes were selected at random rather than individual participants. Consequently, Class X5 and Class X7 were selected as the control and experimental groups, respectively, comprising 35 students per class for a total sample of 70. While the experimental group engaged with Animaker-based audiovisual media, the control group followed standard, conventional teaching methods

Tests were used to collect data by administering test items to students, with the primary objective of measuring mathematical literacy skills. The test format applied was a post-test, administered after the intervention was completed. This stage was conducted to detect any changes or improvements in students' learning outcomes. Documentation serves as a supplementary method of data collection, involving the gathering of files, images, or videos that record the research process. This evidence provides a supporting foundation to ensure the final report is comprehensive and reliable.

The instruments used in this study were tests. The test instrument consisted of a post-test designed in accordance with the ATP and mathematical literacy indicators. The mathematical literacy indicators used in this study were based on those proposed by the *Organization for Economic Co-operation and Development* (2013) within the framework of PISA 2012, namely:

1. The ability to transform or present real-life problems into mathematical concepts, models, or statements is called formulate.

2. The ability to apply appropriate mathematical concepts, facts, rules, and steps to solve a problem is known as the ability to employ.
3. The ability to understand, evaluate, and translate the results of mathematical calculations back into the context of the original problem so they have appropriate meaning is referred to as interpret.

The purpose of administering this test is to measure improvements in students' abilities following the intervention and thereby determine the effectiveness of the instructional media. Before being used for data collection, the test instrument was first evaluated for validity, reliability, difficulty level, and discriminative power to ensure the quality of the test items and to confirm that the instrument is suitable for use, objective, and capable of providing accurate and consistent measurement results in line with the research objectives. The validity test using Aiken's V content validity coefficient showed that all test items fell into the "highly valid" category, with V index values ranging from 0,885 to 1. The reliability test using Cronbach's Alpha yielded a coefficient of 0,782, indicating that the instrument is reliable. In addition, the difficulty index analysis showed that three items were in the acceptable category, one in the easy category, and one in the difficult category. Meanwhile, the results of the discriminant index test showed that all test items fell into the "excellent" category, with discriminant validity indices ranging from 0,682 to 0,814. The results of the mathematical literacy test instrument are shown in the Table 3.

Table 3. The Results of Item Analysis

No soal	Validity	Category	Difficulty Index	Category	Discriminant Index	Category
1	1,000	Highly Valid	0,691	Acceptable	0,811	Excellent
2	0,885	Highly Valid	0,769	Easy	0,684	Excellent
3	0,885	Highly Valid	0,675	Acceptable	0,706	Excellent
4	0,923	Highly Valid	0,51	Acceptable	0,682	Excellent
5	0,885	Highly Valid	0,213	Difficult	0,814	Excellent

Based on the instrument validity test results, items 1, 3, and 4 met all established criteria and were therefore used as the posttest instrument in this study. Each of the three selected items simultaneously measured the three OECD mathematical literacy processes, namely formulate, employ, and interpret. Item 2 was excluded because its relatively great difficulty index (easy category) reduced its ability to challenge students' higher-order mathematical literacy skills. Meanwhile, Item 5 was excluded because its difficult category was considered less appropriate for the posttest, as it could disproportionately affect students' overall performance. Therefore, the final posttest consisted of three balanced essay items that adequately represented all

mathematical literacy indicators while maintaining an appropriate level of difficulty. After the intervention was administered, both the control and experimental classes were assessed with a post-test. Subsequently, the data were analyzed using the Shapiro-Wilk normality test, the Levene's test for homogeneity, and the Mann-Whitney U test.

RESULTS AND DISCUSSION

1. Post-Test Results on Mathematical Literacy Skills

This section presents the post-test results for mathematical literacy from both the experimental and control groups following the intervention. These measurements were subjected to statistical analysis to evaluate the study's hypotheses. Table 4 provides a comprehensive summary of the performance percentages achieved by both groups in the final assessment.

Table 4. Post-Test Results Data

Measuremet	Experimental Class	Control Class
Highest Score	100	83,33
Lowest Score	33,33	3,33
Mean	74,86	50,38
Standard Deviation	26,94	23,99

Comparing the final test results detailed in Table 4, the experimental class demonstrated a higher mean score of 74.86, whereas the control class averaged 50.38. The experimental group's scores ranged from 33.33 to 100, with a standard deviation of 26.94, while the control group's scores ranged from 3.33 to 83.33, with a standard deviation of 23.99. These metrics show that, despite the greater data spread in the experimental group, its overall learning outcomes were clearly superior. Consequently, it can be inferred that the mathematical literacy competencies of the experimental class are more developed than those of the control class.

2. Achievement of Mathematical Literacy Indicators

To provide a thorough overview of mathematical literacy, the researchers analyzed attainment for each indicator separately in the experimental and control classes. The evaluation addressed the three OECD-based processes of formulating, employing, and interpreting. Data corresponding to these indicators are illustrated in Table 5.

Table 5. Students' Achievement on Mathematical Literacy Indicators

Mathematical Literacy Indicators	Experimental Class n (%)	Control Class n (%)
Formulate	29 (82.86%)	22 (62.86%)
Employ	28 (80.00%)	20 (57.14%)
Interpret	26 (74.29%)	19 (54.29%)

Table 5 presents students' achievement for each mathematical literacy indicator in both groups. Overall, the experimental class demonstrated higher achievement than the control class across all three mathematical literacy processes. In the Formulate indicator, 29 students (82.86%) in the experimental class successfully met the indicator, compared with 22 students (62.86%) in the control class. This finding suggests that students who learned using Animaker-based audiovisual media were better able to identify relevant information from contextual statistical problems and translate it into appropriate mathematical models. Similar results were found for the Employ indicator. A total of 28 students (80.00%) in the experimental class met this indicator, whereas only 20 students (57.14%) in the control class did. This indicates that the experimental group was more successful in applying statistical concepts, selecting appropriate procedures, and carrying out mathematical reasoning to solve contextual problems. For the Interpret indicator, the experimental class also outperformed the control class, with achievement percentages of 74.29% and 54.29%, respectively. Although this indicator showed the lowest level of achievement in both groups, students who learned with Animaker-based audiovisual media demonstrated a better ability to interpret statistical results and relate them to the problem context.

Overall, these findings indicate that the implementation of Animaker-based audiovisual media contributed to improvements across all dimensions of mathematical literacy. The largest percentage of achievement was observed in the Formulating indicator, while the Interpreting indicator remained the most challenging for students in both groups. These findings indicate that students who learned using Animaker-based audiovisual media demonstrated stronger performance in all three mathematical literacy processes than students who received conventional instruction.

3. Normality Test

Before proceeding to further statistical analysis, the data were assessed for normality to determine whether parametric or nonparametric tests were required. The Shapiro–Wilk method was adopted as the primary testing technique. The decision-making criteria as follows: a p-

value greater than 0.05 indicates a normal distribution, while p-value of 0.05 or less suggests a departure from normality. The results of this analysis are summarized in Table 6.

Table 6. Normality Test Results

	Kolmogrov-Smirnov[a]			Shapiro-Wilk.		
	Statistic	df	Sig.	Statistic	df	sig
Experimental Class	.239	35	.000	.810	35	.000
Control Class	.247	35	.000	.853	35	.000

a. Liliefors Significance Correction

The Shapiro–Wilk test was employed to examine the distribution of post-test scores for both the experimental and control groups. The analysis revealed that significance values for both classes were $p < 0.05$. Consequently, as the data failed to meet the assumption of normality, non-parametric statistical analysis was deemed necessary. Therefore, the Mann–Whitney U test was used to test the hypothesis.

4. Homogenity Test

Levene's test was used in this study to assess homogeneity of variance across the research groups. The analysis follows the standard criterion: a p-value ≥ 0.05 indicates homogeneous data, while a p-value < 0.05 suggests heterogeneous variance. The resulting statistics from this test are summarized in the subsequent Table 7.

Table 7. Homogeneity Test Result

		Levene Statistic	df1	df	sig
Post-Test Result	Based On Mean	.387	1	68	.536
	Based On Median	.005	1	68	.946
	Based On Median and With adjusted df	.005	1	53.091	.946
	Based On trimmed mean	.317	1	68	.575

The results of the analysis using Levene's test show that the p-value obtained for both sample groups, the experimental class and the control class, is 0.536. According to the decision rule, since $0.536 \geq 0.05$, it can be concluded that all data in this study are homogeneous.

5. Hypothesis Testing

Due to the non-normal distribution of the data, a non-parametric Mann-Whitney U test was employed for hypothesis testing. The results are presented in Table 8.

Table 8. Hypothesis Testing Result

	Post-Test Result
Mann-Whitney U	310.000
Wilcoxon W	940.000
Z	-3.566
Asymp. Sig. (2-tailed)	.000

a. Grouping Variabel: Class

The results of the Mann-Whitney U test show a U value of 310.000, a Z value of -3.566, and an Asymp. Sig. (2-tailed) value of 0.000. The test decision is based on the significance value (p-value). Since the p-value is less than 0.05 (0.000 < 0.05), H_0 is rejected, and H_1 is accepted. This indicates a significant difference in mathematical literacy skills between students who learn with Animaker-based audiovisual media and those who learn through conventional instruction.

6. Effect Size

To examine the practical significance of the intervention, Cohen's d was used to calculate the effect size. The experimental class achieved a higher mean post-test score (M = 74.86, SD = 23.99) than the control class (M = 50.38, SD = 26.94). The analysis yielded a Cohen's *d* value of 0.96, which is classified as a large effect according to Cohen's criteria. This result indicates that the implementation of Animaker-based audiovisual media produced a substantial improvement in students' mathematical literacy compared with conventional learning.

Overall, these findings demonstrate that the use of Animaker-based audiovisual media generated a practically meaningful educational impact, with statistically significant differences in students' mathematical literacy. The large effect size shows that the instructional media significantly contributed to students' ability to formulate mathematical situations, employ mathematical concepts and procedures, and interpret mathematical results in the context of statistical problems.

The findings of this study indicate that students who learned using Animaker-based audiovisual media achieved higher mathematical literacy than those who received conventional instruction. Based on the post-test between the experimental and control groups, it is evident that students in the experimental class using Animaker-based audiovisual media demonstrated higher levels of mathematical literacy than those in the control class using conventional teaching methods. The average post-test score for the experimental class was 74,86, while that for the control class was 50,38. The presence of the control class as a comparison group reinforces the evidence that the use of Animaker-based audiovisual media in mathematics instruction has a positive impact.

The difference in learning outcomes between the experimental and control classes resulted from different teaching approaches in presenting the material, particularly in supporting the development of students' mathematical literacy. The use of audiovisual media proved effective as a tool for bridging understanding of abstract mathematical concepts into more concrete visual forms, thereby enabling students to process information more deeply

(Novrianti & Yusaini, 2018). These media facilitate students' construction of more coherent mental models, which serve as a crucial foundation for mathematical literacy. Furthermore, students' active engagement during the learning process, supported by audiovisual media, not only increases their interest but also directly encourages them to reason and explore mathematical problems in more creative and critical way (Sudianto et al., 2023). By presenting complex concepts in simpler terms and through dynamic visuals, these media allow students to focus more on the problem-solving process (mathematical literacy) rather than merely memorizing mathematical procedures (Darwata & Handican, 2023).

Hypothesis testing yielded an Asymp. Sig. (2-tailed) value of 0.00. In accordance with established criteria, this value meets the requirement of $0.00 < 0.05$; therefore, the null hypothesis (H_0) was rejected, and the alternative hypothesis (Ha) was accepted. These results provide strong evidence of a statistically significant difference in mathematical literacy skills between students in the experimental and control classes. Furthermore, the effect size analysis yielded a value of 0.96, indicating a large intervention effect. This result suggests that the Animaker-based audiovisual media not only produced statistically significant improvements but also had substantial practical significance in enhancing students' mathematical literacy skills. Therefore, the use of Animaker-based audiovisual media had a more optimal impact on students' ability to understand and solve mathematical problems than conventional learning.

The higher mathematical literacy performance of students in the experimental class compared with those in the control class can be explained by the alignment between the features of Animaker-based audiovisual media and the OECD's mathematical literacy indicators. This finding is consistent with the Cognitive Theory of Multimedia Learning, which posits that presenting information through visual and auditory channels simultaneously can reduce students' cognitive load (Mayer, 2009). Previous studies have also reported that interactive media in trigonometry learning contribute positively to students' mathematical literacy (Majid et al., 2025). Audiovisual media facilitate the integration of verbal and visual information, thereby helping students construct more coherent mental models of mathematical concepts, which are often abstract.

The indicator-level analysis provides further insight into how the intervention supported different aspects of mathematical literacy. The highest achievement in the experimental class was observed in the Formulate indicator (82.86%), compared with 62.86% in the control class. This finding suggests that students benefited from the contextual visualizations in the instructional videos, which helped them identify relevant information, recognize relationships

in the data, and translate real-world situations into mathematical representations. This result is consistent with the principles of Freudenthal (Zulkardi et al., 2019), which emphasize that contextual problems should be the starting point for mathematical thinking. Similarly, (Husnah et al., 2025) reported that students who learned through instructional videos demonstrated strong mathematical literacy performance. These findings indicate that contextual video-based instruction helps students develop meaningful connections between real-world situations and mathematical representations, making it easier for them to formulate mathematical problems before determining an appropriate solution strategy.

A similarly positive pattern was observed for the Employ indicator, with the experimental class achieving 80.00%, compared with 57.14% in the control class. The animated presentation of solution procedures enabled students to follow each step systematically when determining statistical measures such as the mean, median, mode, and measures of data dispersion. Rather than simply presenting formulas, the videos illustrated the reasoning behind each procedure, allowing students to apply appropriate mathematical concepts and procedures more accurately. This finding supports Dual Coding Theory (Bi, 2021), which argues that integrating verbal explanations with visual representations enhances students' understanding and procedural performance.

Although the experimental class also achieved higher performance than the control class on the Interpret outcomes indicator, with achievement rates of 74.29% and 54.29%, respectively, this indicator remained the lowest-performing aspect in both groups. This finding indicates that interpreting mathematical results in real-world contexts was the most challenging aspect of mathematical literacy, as it requires students not only to perform calculations accurately but also to evaluate the results' meaning and justify their conclusions based on contextual information. These higher-order reasoning processes generally require more extensive learning experiences and repeated practice than procedural skills alone. Nevertheless, the use of Animaker-based audiovisual media appears to have supported students in developing these skills by presenting dynamic graphs, tables, diagrams, and contextual animations that encouraged them to move beyond simply obtaining correct answers toward making sense of mathematical results within authentic situations. Through these contextual visualizations, students were better able to explain the meaning of their answers in relation to the given problem context. This finding is consistent with (Darwata & Handican, 2023)., who reported that animated videos in mathematics instruction help students visualize mathematical concepts

more clearly, thereby facilitating deeper understanding and interpretation of mathematical information.

Overall, the use of Animaker-based audiovisual media has been shown to support the entire mathematical literacy process, from formulating problems to applying mathematical concepts to interpreting problem-solving results. This support for these three indicators has led to greater development of students' mathematical literacy skills in the experimental class than in the control class, which followed a conventional, largely one-way teaching approach.

The findings of this study are consistent with previous research on the development of Animaker-based animated video content for mathematics learning. That research reported that the use of animated videos as a learning medium was associated with more positive learning outcomes in students' mastery of mathematical concepts than conventional instruction with limited use of visual media (Situmorang, et al., 2023). Similarly, (Setiawan et al., 2024) argued that audiovisual media are designed to adapt to students' learning situations, making mathematical content more relevant to real-life contexts and providing meaningful learning experiences that support the development of mathematical literacy. Likewise, (Putra et al., 2026) emphasized that audiovisual media play an important role in mathematics instruction by visualizing real-world problem contexts, facilitating students' understanding of mathematical information in ways that are less readily achieved through conventional learning environments.

Furthermore, the findings suggest that the use of Animaker-based audiovisual media provides meaningful support for students in understanding abstract mathematical concepts while fostering an enjoyable and participatory learning environment. This may explain why students in the experimental class demonstrated higher levels of mathematical literacy than those in the control class. These findings are consistent with (Aisyah & Rayungsari, 2024), who highlighted the value of audiovisual media in creating engaging learning experiences that support students' conceptual understanding. Similarly, (Sazali et al., 2024) reported that audiovisual media can be successfully integrated into both face-to-face and online learning, providing flexible learning experiences across different instructional settings. In addition, Asniarti et al., (2025) argued that the use of audiovisual media is well aligned with the demands of 21st-century education and the implementation of the Merdeka Curriculum, both of which emphasize meaningful, technology-supported learning. Specifically, animation as a form of audiovisual media offers an engaging way to present mathematical ideas and capture students' attention, making classroom learning more interactive and supporting the overall learning process (Sidabutar & Reflina, 2022).

Based on the findings and discussion, this study shows that students who learned with Animaker-based audiovisual media achieved higher mathematical literacy than those who received conventional instruction. The difference appears in both the overall posttest results and the three OECD mathematical literacy processes. Students in the experimental class scored highest on Formulate, followed by Employ, while Interpret remained the most challenging for both groups, although the experimental class scored higher than the control class. These findings show how Animaker-based audiovisual media support different dimensions of mathematical literacy by helping students translate contextual situations into mathematical representations, apply appropriate mathematical procedures, and interpret mathematical results in real-world contexts. The study therefore contributes not only by showing differences between the experimental and control classes but also by providing indicator-level evidence of how audiovisual media support specific mathematical literacy processes. Given its alignment with technology-enhanced learning, the Merdeka Curriculum, and the development of 21st-century competencies, Animaker-based audiovisual media are a promising alternative for mathematics instruction in both face-to-face and online learning environments.

Despite these positive findings, several limitations should be acknowledged. First, this study employed a post-test only control group design. Therefore, improvements in individual students' mathematical literacy could not be directly compared with their initial abilities. Second, the study involved only two classes from a single senior high school, limiting the generalizability of the findings to broader educational settings. Third, the intervention was conducted over a relatively short period and measured only immediate learning outcomes. Consequently, this study does not provide evidence regarding the long-term retention of mathematical literacy skills after the intervention. Future studies are therefore recommended to involve larger and more diverse samples, implement longer intervention periods, and examine students' long-term retention and transfer of mathematical literacy across different mathematical topics.

CONCLUSION

In conclusion, this study demonstrates that 10th-grade students who were taught using Animaker-based audiovisual media achieved significantly higher scores in mathematical literacy than those who received conventional instruction on data central tendency and dispersion. This finding is supported by the hypothesis test, which yielded an Asymp. Sig. (2-tailed) value of 0.00 ($p < 0.05$), indicating a statistically significant difference between the

experimental and control classes. Furthermore, the large effect size (0.96) suggests that the observed difference is not only statistically significant but also educationally meaningful. The novelty of this study lies in providing empirical evidence that Animaker-based audiovisual media support different dimensions of mathematical literacy in the context of statistics learning, particularly across the OECD processes of Formulate, Employ, and Interpret, with the highest achievement observed in the Formulate indicator. Nevertheless, this study was limited to one school, one mathematics topic, and a posttest-only control group design, which restricts the generalizability of the findings and prevents the examination of changes in students' mathematical literacy over time. Future research is therefore recommended to investigate the use of Animaker-based audiovisual media across broader mathematical topics, larger and more diverse student populations, and research designs that include pretest–posttest measures to provide a more comprehensive understanding of its contribution to mathematical literacy.

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