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The Effectiveness of Interactive Multimedia "HEROKIDS" on Digital and Cultural Literacy: Reviewed from Students' Cultural Interests and Frequency of Smartphone Use

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ABSTRACT (9 pt)

Objective: *This study aims to examine the effectiveness of HEROKIDS, an interactive multimedia application based on the local wisdom of Kediri Regency, in improving cultural and digital literacy among elementary school students.* ***Methods:*** *The study employed a quasi-experimental design with a one-group pre test - post test approach involving 30 fifth-grade students from two public elementary schools in Kediri. Data were collected using validated multiple-choice tests for cultural literacy and structured observation sheets for digital literacy. Two learner-based moderator variables—cultural interest and smartphone usage frequency—were analyzed through median-split grouping. Statistical analyses were conducted using paired sample t-tests and independent sample t-tests.* ***Results:*** *The results indicate that HEROKIDS effectively enhances students' literacies, as evidenced by a significant improvement in cultural literacy (N-gain = 0.81, $p < 0.001$) and digital literacy (N-gain = 0.63, $p < 0.001$). Cultural interest did not moderate the outcomes significantly ($p = 0.677$), suggesting that the intervention was equally effective regardless of students' initial interest. In contrast, smartphone usage frequency showed a significant moderating effect ($p = 0.001$), with students who were more familiar with smartphones demonstrating higher gains.* ***Novelty:*** *This study introduces HEROKIDS as a culturally grounded interactive multimedia that not only improves essential 21st-century literacies but also demonstrates nuanced interaction with students' digital habits. The integration of local cultural values within a digital platform, assessed alongside learner characteristics, offers new insights into how contextualized digital tools can support equitable and engaging literacy development in elementary education.*

INTRODUCTION

The advancement of information and communication technology has brought significant changes in the world of education, including in the way teachers teach and students learn. Amidst these dynamics, literacy skills are the main foundation that students need to master (Wahid et al., 2024). Strong literacy makes students ready to face the challenges of the 21st century as active and responsible citizens in the digital era (Ilhan et al., 2025).

Of the six basic literacies recommended by the (World Economic Forum, 2015), cultural literacy and digital literacy play an important role in shaping the character of students who are technologically literate and rooted in local cultural identity (Minsih et al., 2025; Yang et al., 2025). Cultural literacy is a person's ability to understand and respond to culture, which includes values, norms, customs, art, history, and social institutions, cultural literacy includes the ability to analyze and interpret culture, as well as appreciate and appreciate various types of culture that exist in society (Falimu, 2023). Cultural literacy is important to be provided at the family, school, and community levels because it not only saves and develops national culture, but also builds the identity of the Indonesian nation in the midst of the global community.

Research shows that teachers who have less knowledge about students' cultural differences tend to have cultural prejudices, do not communicate effectively with

students' parents, and are less sensitive to the culture in the classroom (Kale et al., 2023). Cultural literacy also plays an important role in the development of self-reflection; students who master cultural literacy will be better able to understand diversity and become agents of change in building an inclusive society (Singh, 2022).

According to the Metiri Group and the North Central Regional Education Laboratory, there are 10 indicators of cultural literacy in the "Profile of Culturally Literate Students", namely: (1) awareness of culture, (2) awareness of history and its impact, (3) perspective taking – history, (4) stereotypes and bias, (5) tolerance, (6) language proficiency, (7) interaction with individuals from different cultures, (8) use of resources from different cultures, (9) awareness of the influence of technology on world views, and (10) technological environmental culture (Genetic Counseling Cultural Competence Toolkit, 2009). In this study, the measurement of cultural literacy focused on three main indicators: (1) awareness of culture, (2) awareness of history and its impact, and (3) tolerance.

In parallel with the importance of cultural literacy, digital literacy has also emerged as a key competency in today's education landscape. Digital literacy, as explained by Gilster (1997), is the ability to use digital tools in everyday life. Within classroom learning, digital literacy refers to the capacity to utilize digital tools to facilitate educational processes, which involves the ability to search for information on the internet, critically appraise the reliability of various sources, and create original as well as informative outputs by employing multiple forms of digital media. (Kurniadi et al., 2023; Setyaningsih et al., 2019; Wahab et al., 2022). Digital literacy plays a crucial role in the learning process, as it equips students with competencies aligned with contemporary demands, including the ability to think critically, process and evaluate information, engage in online collaboration, and uphold both security and ethical standards in the use of technology.

The importance of digital literacy is growing stronger in the digital era. This aligns with Shopova (2014), who states that digital literacy is fundamental for students to participate effectively in a digital era. Similarly, Kong (2014) It emphasizes that digital literacy allows students to comprehend, examine, and critically assess digital information, while also fostering their ability to produce and disseminate content in a responsible manner. Therefore, integrating digital literacy into learning can enhance students' motivation and improve academic outcomes.

According to UNESCO (2018), there are seven areas of digital literacy in the Digital Literacy Global Framework, namely: 1) devices and software operations, 2) information and data literacy, 3) communication and collaboration, 4) digital content creation, 5) digital safety, 6) problem-solving, and 7) career-related competences. In the context of this study, the effectiveness of HEROKIDS interactive multimedia is reviewed from four main areas of digital literacy, namely: 1) device and software operations, 2) information and data literacy, 3) communication and collaboration, and 4) problem solving. The measurement instrument used is a modification of Afandi et al. (2024).

Based on the importance of cultural and digital literacy. One of the main challenges is the lack of learning media that can convey local cultural material in an interesting way and according to the context of students' lives (Aka et al., 2023). Local wisdom material in government textbooks tends to be general and does not reflect the diversity of regional cultures in depth. On the other hand, the potential of digital media such as interactive multimedia based on Android applications on smartphones has not been maximized effectively, even though the use of digital devices such as smartphones is

very familiar to students, although it is used more for entertainment (Andersson, 2022; Martín-García et al., 2024; Webster & Paquette, 2023).

Interactive multimedia is a combination of text, sound, video, graphics, and animation in an educational context (Adeyele, 2024). This media combines the power of visuals, audio, and interactivity with local cultural content to create a more immersive and meaningful learning experience (Domínguez et al., 2025; Mungsoongnern et al., 2025). In addition to the five basic elements, Munir (2015) added one important element, namely interactivity, which allows students not only to be recipients of information, but also controllers of the learning. To produce effective multimedia, it is important to pay attention to the principles of multimedia learning design such as coherence, signaling, redundancy, spatial contiguity, and temporal contiguity (Mayer, 2009). A study by Kadarsih & Fitria (2022) shows the role of Android-based multimedia in improving motivation and learning outcomes.

In response to these challenges, researchers have developed valid and practical local wisdom-based interactive multimedia to support cultural literacy while encouraging students' digital literacy. The interactive multimedia in question is titled Heritage Exploration of Kediri for Kids (HEROKIDS). Here's how it looks.

Figure 1. Main Menu (From Top Left: Instruction, Let's Learn, Learning Objectives, Test My Ability, and Information Menu)

Figure 2. Let' Learn Menu (Form left: Folklore, Traditions, Arts, Typical Clothing, Typical Food Activity)

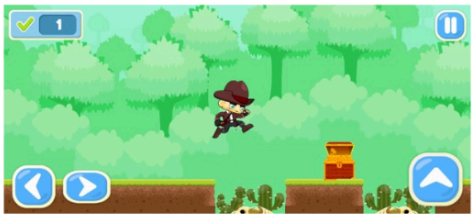

Figure 3. My Ability Test Menu (Games with questions)

Several previous studies have shown the effectiveness of interactive multimedia in improving student learning outcomes and motivation. Research shows that students who learn using a combination of words and images gain better understanding than those who only use words (Lestari et al., 2024). Multimedia-based learning environments also tend to encourage active participation, turning passive students into active participants who explore and interact with content (Dhanil & Mufit, 2021; Irmawan et al., 2022). Furthermore, interactive multimedia has been shown to significantly improve students' cognitive achievement compared to conventional learning methods (Heynoek et al., 2022; Nivetiken et al., 2024). Dhanil & Mufit (2021) emphasized that interactive elements in multimedia can increase students' cognitive engagement in understanding difficult concepts. Similar findings also show a significant increase in science and mathematics literacy through interactive media (Putri Rangkuti & Fakriza, 2024; Suwiantini et al., 2021; Yuningsih et al., 2022).

In Indonesia, a number of studies have developed interactive multimedia based on local wisdom from regions such as Bali, Madura, Toraja, Tulungagung, and Berau (Adiningsih, 2023; Nurcahyani, 2022; Siswoyo et al., 2023; Zulqadri & Nurgiyantoro, 2023). However, the main focus of these studies is still on validity, practicality, and general effectiveness, without considering the individual characteristics of students that may moderate the success of media use. The individual characteristics of students in question can be in the form of cultural interests and frequency of smartphone use.

The theory of interest development by Hidi & Renninger, (2006) explains how interest evolves from situational to enduring individual interest, enhancing learning engagement—principles that, while not explicitly addressing cultural interest, are applicable in local cultural education, as seen in this study through students' enthusiasm for cultural learning, participation in events, and familiarity with Kediri's traditions, in response to the cultural identity threats posed by westernization (Astari et al. 2024). Within this context, cultural interest and smartphone use frequency are two individual factors that may moderate the impact of interactive multimedia on cultural and digital literacy, yet their roles remain underexplored in previous research.

The potential findings may arise from the presence of these two moderator variables. For example, students with high interest in local culture may show greater increases in cultural literacy due to strong affective engagement. However, students with low interest also have the potential to experience significant improvements if HEROKIDS multimedia is able to generate new interests through interesting and contextual learning experiences. So, if it is effective, will its effectiveness be influenced by this multimedia or is it indeed the innate interest of the students towards.

In terms of smartphone use frequency, students who rarely use smartphones may feel more motivated by the novelty of digital media like HEROKIDS, while those who are more accustomed can navigate and utilize its features more effectively, raising the question of whether observed learning gains are due to the media itself or the students' prior digital habits. The relationship between smartphone use and media effectiveness relates to students' digital fluency, which was explored through questions on average daily usage, types of apps accessed, and use for academic searches; studies by Caesar et al. (2023) noted that smartphone behavior reflects student attitudes, though they emphasized the importance of digital awareness over cultural insight, while Mawardiningsih & Mediantara (2021) highlighted how increased smartphone use during the pandemic disrupted traditional cultural interaction, in contrast to Wijayanto & Suib (2021), who found it could foster youth engagement in local cultural activities.

Thus, this study not only aims to determine the effectiveness of interactive multimedia Heritage Exploration of Kediri for Kids (HEROKIDS) based on Kediri local wisdom in improving students' cultural literacy and digital literacy, but also explores how the effectiveness is reviewed from cultural interests and frequency of smartphone use as moderator variables. This is an important novelty, because it allows for a more adaptive and personal learning model based on student characteristics.

Based on this background, the research question is

RQ 1. Is HEROKIDS interactive multimedia based on local wisdom effective in improving the cultural literacy of elementary school students?

RQ 2. Is there a difference in the effectiveness of local wisdom-based interactive multimedia HEROKIDS on students with low and high cultural interests?

RQ 3. Is HEROKIDS interactive multimedia based on local wisdom effective in improving the digital literacy of elementary school students?

RQ 4. Is there a difference in the effectiveness of local wisdom-based interactive multimedia HEROKIDS on students who have low and high smartphone usage frequencies?"

RESEARCH METHOD

Design

This study uses a quantitative approach with a quasi-experimental design of the one group pretest and post-test design. This design is used to measure the effectiveness of the use of interactive multimedia "HEROKIDS" based on local wisdom of Kediri Regency in improving cultural literacy and digital literacy of elementary school students, by considering two categorical moderator variables, namely interest in local culture and frequency of smartphone use. Here is the picture

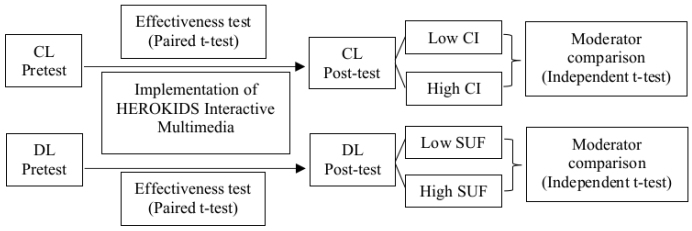

Figure 4. Research Design

Note
CL : Cultural Literacy
DL : Digital Literacy
CI : Cultural Interest
SUF : Smartphone Usage Frequency

In this study involved three types of variables. The independent variable is the use of HEROKIDS interactive multimedia (for download this app: https://s.id/HEROKIDS). The dependent variable consists of two aspects, namely cultural literacy and digital literacy. Meanwhile, the moderator variable includes two categories: the level of interest in local culture (differentiated into low and high) and the frequency of smartphone use (also categorized as low and high). The grouping of high and low categories was carried out based on the median division of the initial classification questionnaire scores. This approach was chosen because there were no standard scoring guidelines and considering the limited number of participants.

Participant

The subjects of this study were all fourth grade students from two elementary schools in Gurah District, Kediri Regency, East Java, Indonesia, namely State Elementary School Adan-Adan 2 as many as 16 students and State Elementary School Tiru Kidul 1 as many as 14 students, so that the total number of research participants was 30 students. The selection of subjects was carried out purposively, considering the readiness of teachers and students in using smartphones for learning. The study was conducted in May 2025, with the location of learning activities and data collection taking place in each school.

Instrument

Data collection instruments consist of two main types. Cultural literacy is measured through a multiple-choice test based on HEROKIDS content, covering aspects of cultural awareness, history, and tolerance. Of the 25 questions compiled, 20 questions were declared valid (all item > .05) and reliable (α = .96 > .70). Digital literacy is measured using a Likert scale observation questionnaire (interval 4) covering aspects of device operation, data literacy, communication-collaboration, and problem solving. The results of all 8 items were declared valid (all item > .05) and reliable (α = .89 > .70). Both the cultural literacy questions and the digital literacy observation sheet have been validated by experts and tested for items at State Elementary School Adan-Adan 1. In addition to the two main instruments above, there is a classification questionnaire to measure students' cultural interests and frequency of smartphone use.

Procedure

Research procedure and collection data was conducted in two meetings. In the first meeting, students were given a pretest to measure cultural literacy before learning began. After that, they participated in learning using HEROKIDS multimedia. In the same meeting, the first observation was conducted on students' digital literacy behaviour using an observation questionnaire. The second meeting was continued with further learning using different topics in the HEROKIDS application. At the end of the meeting, students were given a cultural literacy post-test and were observed again using the same digital literacy instrument.

Data Analysis

The data obtained were analyzed quantitatively. For RQ 1 and RQ 3, paired sample t-test was used to compare pretest and post-test scores, both cultural literacy and digital literacy. In addition, N-gain calculations were carried out to see the increase in students' abilities. The analysis for RQ 2 and RQ 4 was by comparing the results of cultural literacy between students with low and high cultural interest moderators and low and high smartphone usage frequency moderators after usage of interactive multimedia HEROKIDS, the comparison using an independent t-test.

The entire RQ uses the assumption of 95% confidence significance. Before the difference test is carried out, each data will be tested for normality using Shapiro-Wilk, and the homogeneity test using Levene's test. Furthermore, a hypothesis test is carried out. If the data does not meet the normality assumption, a non-parametric test is used.

RESULTS AND DISCUSSION

Results

The Effectiveness of HEROKIDS Interactive Multimedia on Cultural Literacy

Pre-test conducted before learning using interactive multimedia to determine the level of initial cultural literacy of students, while the post-test was conducted after learning to see the effect of using the multimedia. The following table presents the following descriptive statistical results to determine the average increase in cultural literacy and the other data.

Table 1. Descriptive Statistics Results of Pre-test and Post-test

Design	Group	$\bar{x}$	n	SD
Pair	Pre-test Cultural Literacy	33.17	30	1.65
	Post-test Cultural Literacy	87.00	30	1.65

Table 2. Results of the Cultural Literacy Normality Test Using Shapiro-Wilk

Group	n	Sig.	Normality
Pre-test	30	.060	Normal
Post-test	30	.057	Normal

Based on the results of the normality test, a significance value of .060 was obtained for the pre-test group and .057 for the post-test group. Because both values are greater than the significance level of .05, it can be concluded that the cultural literacy data in the pre-test and post-test are normally distributed. Furthermore, homogeneity was tested using the One Way ANOVA method.

Table 3. Results of the Cultural Literacy Homogeneity Test Using Lavene Statistic

Data	df1	df2	Sig.	Homogeneity
Mean Based	1	58	.496	Homogeneous

The results of the cultural literacy homogeneity test using Levene's Statistic show a significance value of .496. Because this value is greater than .05, the data from the pre-test and post-test groups are considered to have the same variance or are homogeneous. With the fulfilment of the prerequisite test, the next step is to carry out a paired t-test. The following is the test result data.

Table 4. Results of the Paired Sample T-Test for Cultural Literacy

Design	Group	$\bar{x}$	SD	t-count	Sig.
Pair	Post-test Cultural Literacy compared to Pre-test Cultural Literacy	53.83	6.91	42.68	.001

Paired Sample T-Test show that the average value of the post-test compared to the pre-test of Cultural Literacy is 53.83 with a standard deviation of 6.91. The t-count value reaches 42.68 with a significance (Sig.) of .001. Because this significance value is smaller than .05 (.001 < .05), it can be concluded that there is a significant difference between the cultural literacy scores of students before and after using the interactive multimedia "HEROKIDS" based on local wisdom of Kediri Regency.

After the paired t-test results are obtained, the analysis is continued with the calculation of the N-gain value to determine the level of effectiveness of the increase in practice. The following is Table 5 which contains the results of the gain score test.

Table 5. Results of Cultural Literacy Gain Score Test

$\bar{x}$		N-gain	Category
Pre-test	Post-test		
33.17	87.00	.81	High

The average value of N-gain shows an increase from 33.17 to 87.00, with N-gain of .81. Referring to the N-gain classification criteria, this value is included in the high category (≥ .70).

The measurement instrument is based on the Profile of Culturally Literate Student framework developed by the Metiri Group and the North Central Regional Education Laboratory. This framework includes three main aspects, namely: (1) awareness of culture, (2) awareness of history and its impact, and (3) tolerance of differences. These three aspects are used as indicators to assess the extent to which students have an understanding and attitude that reflects cultural literacy. The following is a description of the results of measuring the level of cultural literacy of students.

Table 6. Results of Cultural Literacy Level of Awareness of Culture Aspect

No	Aspect	Sub Aspects	$\bar{x}$ Pre Test	$\bar{x}$ Post Test	N-gain Score	N-gain Category
1	Awareness of Culture	Knowledge of culture	30	94.67	.92	High
		Understanding cultural values and meanings	32.22	92.22	.89	High
		Participation in cultural activities	23.33	76.67	.70	High
		Preservation of cultural heritage	35	63.33	.44	Moderate
		Average	30.14	81.72	.74	High

Table 7. Results of the Level of Cultural Literacy in the Awareness of History and Its Impact Aspect

No	Aspect	Sub Aspects	$\bar{x}$ Pre Test	$\bar{x}$ Post Test	N-gain Score	Category N-gain
2	Awareness of History and Its Impact	Understanding of historical events	27.78	78.89	.71	High
		Ability to explain the values of historical events	71.67	95.00	.82	High
		Average	49.72	86.94	.76	High

Table 8. Results of Cultural Literacy Level of Tolerance Aspect

No	Aspect	Sub Aspects	$\bar{x}$ Pre Test	$\bar{x}$ Post Test	N-gain Score	Category N-gain

3	Tolerance	Ability to appreciate and accept cultural differences	24.44	94.44	.93	High

The results of the analysis each aspect show that all aspects experienced a significant increase after the use of HEROKIDS interactive multimedia. In the aspect of awareness of culture (.74). The aspect of awareness of history and its impact (.76), tolerance (.93).

Review of Effectiveness Based on Cultural Interest

The following presents data on the review of the effectiveness of HEROKIDS interactive multimedia based on cultural interests along with the prerequisite tests for normality and homogeneity.

Table 9. Distribution of Cultural Interest Categories

CI Score *)	Interest Categories	f	%
≤ 10	Low	20	67%
> 10	High	10	33%

*) Median = 10

Table 10. Effectiveness Based on Cultural Interest

Cultural Interest Categories	n	Pretest ($\bar{x}$ ± SD)	Post-test ($\bar{x}$ ± SD)	N-gain	Category
Low	20	34.50 ± 9.72	86.50 ± 9.47	.79	High
High	10	30.50 ± 7.25	88.00 ± 8.56	.81	High

Table 11. Shapiro-Wilk Normality Test (Post-Test)

Cultural Interest Categories	n	Sig.	Normality
Low	20	.167	Normal
High	10	.549	Normal

Table 12. Lavene Statistic Homogeneity Test (Post-Test)

Data	df1	df2	Sig.	Homogeneity
Mean Based	1	28	.547	Homogeneous

Table 13. Results of the Independent Sample T-Test for Cultural Literacy

Design	Group	Sig.
Independent	Low cultural interest compared to high	.677

Effectiveness on Digital Literacy

Measurement of digital literacy in this study was conducted to assess the extent to which students' abilities are in using technology effectively and responsibly during the learning process using interactive multimedia "HEROKIDS" based on local wisdom of Kediri Regency.

The following table presents the following descriptive statistical results to determine the average increase in digital literacy and the other data.

Table 14. Descriptive Statistics Results of Pre-test and Post-test

Design	Group	$\bar{x}$	n	SD
Pair	Digital literacy first day scores	60.63	30	5.41
	Digital literacy second day scores	85.63	30	6.39

Table 15. Results of Digital Literacy Normality Test Using Shapiro-Wilk

Group	n	Sig.	Normality
Digital literacy first day scores	30	.052	Normal
Digital literacy second day scores	30	.095	Normal

Based on the results of the normality test, a significance value of .052 was obtained for the first day meeting group and .095 for the second day meeting group. Because both values are greater than the significance level of .05, it can be concluded that the digital literacy data at the first and second meetings are normally distributed. Furthermore, homogeneity was tested using the One Way ANOVA method.

Table 16. Results of Digital Literacy Homogeneity Test Using Lavene Statistic

Data	df1	df2	Sig.	Homogeneity
Mean Based	1	58	.237	Homogeneous

The results of the digital literacy homogeneity test using Levene's Statistic show a significance value of .237. Because this value is greater than .05, the data from the pre-test and post-test groups are considered to have the same variance or are homogeneous. With the fulfillment of the prerequisite test, the next step is to carry out a paired t-test. The following is the test result data.

Table 17. Results of the Paired Sample T-Test for Digital Literacy

Design	Group	$\bar{x}$	SD	t-count	Sig.
Pair	Digital literacy second day scores compared to Digital literacy first day scores	24.93	8.29	16,470	.001

Paired Sample T-Test show that the average value (Mean) of the second day meeting compared to the first day of digital literacy was 24.93 with a standard deviation of 8.29. The t-count value reached 16.47 with a significance (Sig.) of .001. Because this significance value is less than .05 (.001 < .05), it can be concluded that there is a significant difference between the digital literacy scores of students on the first and second days using the interactive multimedia "HEROKIDS" based on local wisdom of Kediri Regency.

After the paired t-test results are obtained, the analysis is continued with the calculation of the N-gain value to determine the level of effectiveness of the increase in practice. The following is Table 18 which contains the results of the gain score test.

Table 18. Results of the Digital Literacy Gain Score Test

$\bar{x}$		N-gain	Category
Digital Literacy First Day Scores	Digital Literacy Second Day Scores		
60.63	85.63	.63	Moderate

Based on Table 18 above, it can be seen that the average value of N-gain shows an increase from 60.63 to 85.63, with N-gain of .63. Referring to the N-gain classification criteria, this value is included in the moderate category.

Regarding digital literacy, the observation instrument was developed based on four main aspects of digital literacy, according to UNESCO (2018) in the Global Framework of Reference, namely 1) device and software operations, 2) data information and literacy, 3) communication and collaboration, 4) problem solving. Observations were carried out in two meetings, with score-based assessments for each aspect, allowing for gradual analysis of digital skill development. The following is a description of the results of measuring the level of digital literacy of students.

Table 19. Results of Digital Literacy Levels in Device and Software Operation

No	Aspect	Indicator	$\bar{x}$ First Day Scores	$\bar{x}$ Second Day Scores	N-gain Score	N-gain Category
1	Device and Software Operations	Students can search for and install multimedia applications correctly and independently.	57.50	94.17	.86	High
		Students can operate navigation icons, press buttons, scroll pages, and select items in the application menu independently.	50.83	91.67	.83	High
		Average	54.17	92.92	.85	High

Table 20. Results of Digital Literacy Levels in Information and Data Literacy

No	Aspect	Indicator	$\bar{x}$ First Day Scores	$\bar{x}$ Second Day Scores	N-gain Score	N-gain Category
2	Information and Data Literacy	Students are able to search for and use information in the application to answer quizzes and worksheet assignments.	63.33	84.17	.57	Moderate
		Students can optimize information features in multimedia applications	50.83	83.33	.66	Moderate
		Average	57.08	83.75	.61	Moderate

Table 21. Results of Digital Literacy Levels in Communication and Collaboration

No	Aspect	Indicator	$\bar{x}$ First Day Scores	$\bar{x}$ Second Day Scores	N-gain Score	N-gain Category
3	Communication and Collaboration	Students can participate in group discussions when working on multimedia-based worksheet.	60.83	80.00	.49	Moderate
		Students are able to convey answers and opinions clearly, and actively ask questions or respond in discussions.	65.83	81.67	.46	Moderate
		Average	63.33	80.83	.48	Moderate

Table 22. Results of Digital Literacy Level in Problem Solving

No	Aspect	Indicator	$\bar{x}$ First Day Scores	$\bar{x}$ Second Day Scores	N-gain Score	N-gain Category
4	Solution to problem	Students are able to complete all tasks in the worksheet using multimedia applications.	67.50	85.83	.56	Moderate
		Students can complete quiz questions in the Let's Learn menu in the multimedia application.	68.33	84.17	.50	Moderate
		Average	67.92	85.00	.53	Moderate

Based on the results of the analysis of four aspects of digital literacy, it is known that the use of HEROKIDS interactive multimedia has a positive impact on improving students' digital literacy. The aspect of device and software operations showed the highest increase with an average N-gain of .85 (high category), which indicates that students are able to quickly understand how to operate multimedia applications independently. Meanwhile, the other three aspects—information and data literacy (0.61), communication and collaboration (0.48), and problem solving (.53)—showed a moderate increase category.

Effectiveness Review Based on Smartphone Usage Frequency

The following presents data on the review of the effectiveness of HEROKIDS interactive multimedia based on smartphone usage frequency along with the prerequisite tests for normality and homogeneity.

Table 23. Distribution of Smartphone Usage Frequency Categories

SUF Score *)	Smartphone Usage Frequency Categories	f	%
≤ 8	Low	19	63%
> 8	High	11	37%

*) Median = 8

Table 24. Effectiveness Based on Smartphone Usage Frequency

SUF Categories	n	First Day ($\bar{x}$ ± SD)	Second Day ($\bar{x}$ ± SD)	N-gain	Category
Low	19	60.03 ± 5.67	82.40 ± 4.90	.58	Moderate
High	11	61.65 ± 5.06	91.19 ± 4.60	.77	High

Table 25. Shapiro-Wilk Normality Test (Post-Test)

SUF Categories	n	Sig.	Normality
Low	19	.074	Normal
High	11	.112	Normal

Table 26. Lavene Statistic Homogeneity Test (Post-Test)

Data	df1	df2	Sig.	Homogeneity
Mean Based	1	28	.935	Homogeneous

Table 27. Results of the Independent Sample T-Test for Digital Literacy

Design	Group	*Sig.*
Independent	Low Smartphone Usage Frequency Compared To High	.001

Discussion

The Effectiveness of HEROKIDS Multimedia on Cultural Literacy

The results of the data analysis showed that the use of interactive multimedia HEROKIDS was significantly able to improve the cultural literacy of elementary school students. The results above show that HEROKIDS interactive multimedia combines the power of visuals, audio, and interactivity with local cultural content to create a deeper and more meaningful learning experience (Adeyele, 2024; Domínguez et al., 2025; Mungsoongnern et al., 2025). In addition to the five basic elements, Munir (2015) added one important element, namely interactivity, which allows students not only to be recipients of information, but also controllers of the learning process.

The aspect of cultural awareness showed a significant increase, with an N-gain of .74. HEROKIDS interactive multimedia presents cultural information visually, auditorily, and interactively, making it easier to understand and more interesting for students. This is in line with the opinion of Welzer et al. (2010) that cultural awareness is an important foundation for cross-cultural understanding and communication. The second aspect, awareness of history and its impact, also showed an increase with an N-gain of .76, HEROKIDS effectively helps students relate historical events to relevant cultural values, strengthening historical literacy as part of understanding local culture. The third aspect, tolerance towards cultural differences, recorded the highest increase with an N-gain of .93. This indicator shows that learning using HEROKIDS multimedia not only strengthens cultural understanding, but also forms an inclusive attitude and mutual respect among students. This is in accordance with the characteristics of

elementary school-age students who are still in the early stages of social development and are very responsive to visual and contextual experience-based learning approaches.

Overall, these three aspects indicate that HEROKIDS interactive multimedia is able to build cultural literacy as a whole. This supports the views of Falimu (2023) and Singh (2022) that cultural literacy plays an important role in shaping national identity, encouraging self-reflection, and fostering a tolerant and participatory attitude towards local culture. This effectiveness can also be explained through Mayer's (2009) multimedia learning theory which states that the integration of text, image, animation, and audio elements according to the principles of contiguity and coherence can improve the process of understanding and memory retention. When content is delivered visually and interactively, students not only understand information verbally, but also experience it multimodally.

This finding is reinforced by previous studies, such as Padmini et al. (2022), Siswoyo et al. (2023), and Zulqadri & Nurgiyantoro (2023), which show the effectiveness of local culture-based media in education. HEROKIDS has proven to be a relevant innovative solution in addressing the challenge of low cultural literacy in elementary schools through a contextual and enjoyable educational technology-based approach.

Review of the Effectiveness of HEROKIDS Multimedia on Cultural Literacy Based on Cultural Interests

To find out whether students' cultural interests moderate the effectiveness of HEROKIDS multimedia in improving cultural literacy, students were grouped based on the Cultural Interest (CI) score. The test results showed that there is no significant difference between the low and high interest groups in terms of cultural literacy achievement.

This finding is interesting because it shows that HEROKIDS multimedia is able to reach and impact all groups of students equally. Students with high interest are likely to already have an affective interest in culture and are therefore more ready to receive the content, while students with low interest actually get a new boost from the HEROKIDS visual and interactive learning experience. Thus, effectiveness is not solely determined by initial interest, but also by the power of the media in packaging cultural material in a contextual and interesting way.

This finding can be understood within the framework of affective-cognitive theory which states that a person's intrinsic motivation towards a learning content can affect their engagement and cognitive processes (Hidi & Renninger, 2006). Students with a high interest in local culture are likely to have deeper engagement, thus processing information more actively and critically. However, cognitive conflict theory (Dhanil & Mufit, 2021) shows that the mismatch between initial expectations and new stimuli in learning media can trigger new learning interests. This explains how students with low interest were able to show significant improvements. Therefore, the strength of HEROKIDS multimedia lies in its ability to create immersive and engaging learning experiences, which can ultimately activate cognitive engagement even though students' initial interest is low. Local culture-based learning also correlates with contextual learning theory, where the information conveyed is easier to understand when it is related to students' experiences and environment.

The Effectiveness of HEROKIDS Multimedia on Digital Literacy

HEROKIDS interactive multimedia has proven effective in improving digital literacy. This condition shows that students are significantly helped in understanding how digital technology works and its basic use through the HEROKIDS application.

The first aspect is device and software operation. The results of the two indicators in this aspect measured were in the high category (N-gain .85). These results indicate that the intuitive HEROKIDS interface design makes it easier for students to learn independently. This finding is in line with Gilster (1997) who stated that digital literacy includes the ability to access and understand information from various digital sources.

The second aspect is information and data literacy, which includes the ability to use information in the application to answer quizzes and worksheet questions, both in the moderate category. According to Kong (2014), digital literacy helps students understand, analyze, and evaluate digital information critically. HEROKIDS' text, sound, and animation features support this process according to students' learning styles (Diyana et al., 2020; Batubara et al., 2023).

The third aspect is communication and collaboration, which reflects students' ability to interact during the learning process. Two indicators show moderate N-gain (.48). Lestari (2023) stated that interactive multimedia can increase learning motivation through two-way communication, and Masrifah et al. (2023) added that a flexible atmosphere supports students' concentration and comfort in discussions.

The fourth aspect is problem solving, with an N-gain score of .53 in the moderate category. Pribadi (2017) stated that interactive multimedia gives users control and can present information consistently and realistically. HEROKIDS provides an exploratory space that supports digital and contextual problem solving.

The effectiveness of this multimedia is supported by research by Zulqadri (2023) and Dong et al. (2024) which shows that interactive multimedia is effective in improving children's digital literacy. HEROKIDS as an interactive and fun local application has succeeded in creating a meaningful digital learning experience for elementary school students.

Review of the Effectiveness of HEROKIDS Multimedia on Digital Literacy Based on Smartphone Usage Frequency

To find out whether the frequency of smartphone usage (Smartphone Usage Frequency/SUF) moderates the effectiveness of HEROKIDS multimedia in improving digital literacy, grouping was carried out based on the median SUF score. The results of the analysis showed that the high SUF group experienced a higher increase in digital literacy than the low SUF group. This shows that students who are more accustomed to using smartphones tend to be more adaptable and utilize HEROKIDS multimedia features optimally.

This finding is consistent with the digital literacy theory by Gilster (1997) which states that skills in accessing and managing digital information are an important part of modern learning. Learners with high SUF tend to have stronger technical skills and digital exploration habits, so they are more ready to receive application-based learning materials such as HEROKIDS. This is also in line with Kong's (2014) view that digital literacy includes the ability to think critically about digital information, which naturally develops along with the intensity of digital device use.

This finding is also supported by research by Caesar et al. (2023) which states that the frequency of smartphone use is correlated with students' readiness to use technology functionally. Meanwhile, Mawardiningsih and Mediantara (2021) highlighted the importance of guiding smartphone use so as not to interfere with the learning process. In this context, HEROKIDS is able to direct students' smartphone use for learning purposes, not just entertainment.

Thus, the effectiveness of HEROKIDS is not only determined by the quality of the media itself, but is also influenced by the characteristics of the users. Learners with higher smartphone experience showed more positive responses and achievements. However, students with low SUF also experienced significant improvements, indicating that HEROKIDS remains accessible and beneficial to all students. Locally-based digital learning like this has the potential to bridge the digital divide while strengthening cultural content in basic education.

CONCLUSION

The study found that application HEROKIDS in learning resulted in significant improvement in cultural literacy (n-Gain = 0.81) and moderate improvement in digital literacy (n-Gain = 0.63). This indicates that culturally contextualized digital tools can effectively enhance 21st-century skills among young learners. The findings imply that integrating local cultural content with interactive technology offers a promising pedagogical strategy to bridge traditional values and modern literacy needs. However, the study was limited to a specific grade level and short-term outcomes within a localized context, and it only examined two moderating variables—cultural interest and smartphone usage frequency. Future research should broaden the participant base, include long-term impact assessments, and explore additional moderators such as socioeconomic background, teacher facilitation style, and learning preferences to deepen our understanding of the effectiveness and adaptability of locally-based digital learning media.

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