



Development of Local Culture-Based Interactive Media to Improve Children's Mathematics Skills in Kindergarten

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Abstract: This study addresses the limited development of early childhood mathematical abilities, which is often associated with the use of conventional learning approaches and the lack of innovative, technology-based instructional media. The objective of this research is to develop and evaluate local culture-based interactive animated video media to enhance early childhood mathematics skills. This study employed a Research and Development (R&D) approach using the ADDIE model, consisting of analysis, design, development, implementation, and evaluation stages. The product was validated by experts in media, materials, and culture, followed by limited and broader trials involving children aged 5–6 years at Mekar Melati Kindergarten. Data were collected through validation sheets, observation, questionnaires, and pretest–posttest instruments, and analyzed using descriptive statistics and N-Gain scores. The results indicate that the developed media achieved a very high level of validity, with media validation at 100%, cultural validation at 93.75%, and material validation at 98.33%. The practicality test showed a score of 92.5%, indicating that the media is highly feasible for classroom use. Furthermore, the effectiveness test revealed a significant improvement in children's mathematical abilities, with an N-Gain score of 0.768 categorized as high. The findings also demonstrate that integrating local cultural elements into interactive media enhances children's engagement, conceptual understanding, and contextual learning experiences. In conclusion, local culture-based interactive animated video media developed through the ADDIE model is proven to be valid, practical, and effective in improving early childhood mathematics skills. This study highlights the importance of integrating technology and cultural context in early childhood education to support meaningful and engaging learning processes.

Keywords: ADDIE model; Early childhood education; Interactive learning media; Local culture; Mathematics skills

Introduction

Early Early Childhood Education (PAUD) is a strategic foundation in building the quality of human resources because in this phase there is optimal development of various aspects of child development, especially cognitive, social, and emotional (Windayani et al., 2025; Sinclair, 2018). This period is known as the golden age, which is a stage of development that is very sensitive to environmental stimulation so that it requires appropriate and meaningful educational interventions

(Uce, 2017; Sania et al., 2025). The characteristics of early childhood who are still thinking concretely, having high curiosity, and learning through hands-on experience demand the use of contextual and interactive learning approaches (Lestari et al., 2020; Nurasyiah et al., 2023; Gea et al., 2025).

One of the aspects of development that is very important to be stimulated from an early age is early mathematical skills, which are the basis for the development of logical thinking and problem-solving skills at the later stages of education (Darmiyati et al.,

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2020; Wathon, 2024; Al-Hassan et al., 2025). Mathematics skills in early childhood include classification, grouping, sequencing, matching, and the introduction of number concepts that are still concrete and require learning media that are in accordance with the child's developmental stage (Setiyo, 2018; Rahayu et al., 2025). Therefore, mathematics learning in early childhood needs to be systematically designed by utilizing media that is able to concretize abstract concepts into easier to understand (Falloon, 2024; Gordyeyev et al., 2026).

However, various research findings show that mathematics learning practices in PAUD are still dominated by conventional methods that are less varied and have minimal use of technology, so that they have not been able to increase children's active involvement in the learning process (Nurasyiah et al., 2023; Nurfadilah H et al., 2025; Noviarini et al., 2025). This condition has an impact on children's low understanding of basic mathematical concepts such as number recognition, number symbols, grouping of shapes, and simple measurement concepts (Az-Zahra et al., 2025; Darmiyati et al., 2020). In addition, the lack of use of innovative learning media causes the learning process to be monotonous and less interesting for children (Mulyadi et al., 2023; Putri et al., 2025; Rahayu et al., 2025).

In the perspective of constructivist theory, effective learning emphasizes the active role of learners in building knowledge through direct experience and interaction with the environment (Falloon, 2024; Suparlan, 2019; Nurhayati et al., 2025). In line with that, the use of technology-based learning media such as interactive animated videos can provide a more meaningful learning experience because it integrates visual, audio, and interactivity elements (Jilink et al., 2018; Munandar et al., 2024; Susilawati et al., 2023; Suryana et al., 2025). This media is able to help children understand abstract concepts to become more concrete through visual representations that are attractive and easy to understand (Adistiarachma et al., 2025).

On the other hand, the contextual learning approach emphasizes the importance of relating learning materials to children's real lives so that learning becomes more meaningful (Afriliani et al., 2023; Salpina et al., 2024). The integration of local culture in learning media is one of the strategies to create learning experiences that are relevant to children's social environment while instilling local wisdom values from an early age (Safitri et al., 2025; Galugu et al., 2026). The use of local cultural contexts, such as traditional foods and daily activities, has been shown to improve understanding of concepts while strengthening children's cultural identity (Salpina et al., 2024; Kumas, 2024).

Although various studies have examined the effectiveness of interactive media in early childhood learning, there are still limitations in the development of media that simultaneously systematically integrate digital technology and local culture in early mathematics learning. In addition, research that comprehensively examines the validity, practicality, and effectiveness of local culture-based media in improving early childhood mathematics skills is still relatively limited (Az-Zahra et al., 2025; Trisniawati, 2026).

Based on these gaps, this research was conducted with the main reason of developing innovative learning media that is not only based on interactive technology, but also integrates local cultural values so that learning becomes more contextual and meaningful. In addition, this research aims to provide solutions to the limitations of learning media in PAUD and answer teachers' needs for media that is interesting, easy to use, and in accordance with the characteristics of child development.

Thus, the purpose of this study is to develop and test the feasibility and effectiveness of interactive animation video media based on local culture in improving early childhood mathematics skills. The contribution of this research is expected to enrich scientific studies in the field of early childhood education, especially related to the development of innovative and applicable technology-based learning media and local culture.

Method

Time and Location of the Research

This research was carried out from July to December 2025 at Mekar Melati Kindergarten, South Pesisir Regency. The selection of the research location was based on the results of a needs analysis that showed that the institution still has limitations in the use of technology-based interactive learning media and is not optimal in integrating local culture in early childhood mathematics learning. In addition, this condition is relevant to the findings of previous research which showed that the limitation of innovative media is one of the factors inhibiting the development of children's numeracy skills (Nurasyiah et al., 2023; Rahayu et al., 2025).

Research Method

This research uses a Research and Development (R&D) approach which aims to develop and test the feasibility and effectiveness of a learning product (Branch et al., 2010; Sugiyono, 2021). This approach was chosen because it is able to produce empirically tested educational products through systematic stages ranging

from needs analysis to product evaluation (Sugiyono, 2019).

The development model used is ADDIE (Analysis, Design, Development, Implementation, Evaluation), which is known as a systematic, flexible, and adaptive model in the development of technology-based learning media (Branch et al., 2010; Sugiyono, 2021). The use of this model is also supported by previous research that states that ADDIE is effective in producing valid, practical, and effective learning media (Kandriasari et al., 2023; Putri et al., 2025).

The subjects of the study were group B children aged 5–6 years at Mekar Melati Kindergarten. The sampling technique uses saturated sampling, considering the limited number of populations so that the entire population is used as a research sample. Small group trials involve 10 children, while large group trials involve 15 children to test the practicality and effectiveness of the product more broadly.

Development Stage

This procedure refers to the steps in the ADDIE model research and development procedure as shown in figure 1.

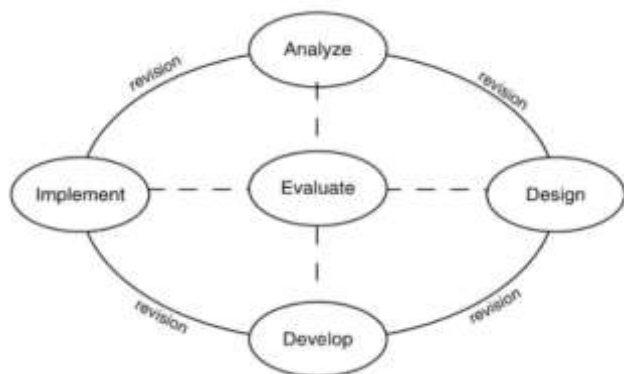


Figure 1. Research procedure

The media development stage follows the ADDIE model procedure which consists of five main stages.

Analysis

This stage includes the analysis of learning needs, children's characteristics, and the condition of the media used in the field. The analysis was carried out through observation and interviews with teachers to identify problems in early childhood mathematics learning.

Design

The design stage includes the preparation of interactive animated video media design based on local culture, the determination of mathematical ability indicators, and the preparation of research instruments.

This design considers the principles of early childhood learning that are concrete and contextual.

Development

At this stage, media products are made and validated by media experts, material experts, and cultural experts. The validation process aims to ensure the suitability of content, appearance, and integration of local culture in the media.

Implementation

The validated media is tested on children through direct learning in the classroom. This stage aims to find out the practicality of using media as well as children's responses during the learning process.

Evaluation

A thorough evaluation is carried out to assess the quality of the product based on aspects of validity, practicality, and effectiveness. This evaluation also includes the analysis of pretest and posttest results to measure the improvement of children's math skills.

Data Analysis

The data in this study was analyzed using quantitative and qualitative descriptive approaches. Quantitative analysis is used to measure the level of validity, practicality, and effectiveness of media through percentage score calculation and learning outcome improvement (N-Gain) tests (Sugiyono, 2019; Rahayu et al., 2025).

The effectiveness of the media was analyzed using the N-Gain formula to determine the improvement of children's mathematical skills before and after the use of media. The N-Gain value is then categorized into low, medium, or high levels to interpret learning effectiveness.

Meanwhile, qualitative analysis was used to interpret the data from observations, interviews, and input from validators and teachers during the trial process. This approach aims to provide a more comprehensive understanding of the advantages and disadvantages of the developed media (Sugiyono, 2021). Data processing is carried out with the help of Microsoft Excel software to make it easier to calculate and present data systematically.

Result and Discussion

The results of the study showed that the interactive animation video media based on local culture developed through the ADDIE model met the criteria of valid, practical, and effective in improving early childhood mathematics skills. The validity of the product is obtained through the assessment of media experts,

subject matter experts, and cultural experts who show that the media has met the aspects of content feasibility, conformity with early childhood characteristics, visual display quality, and integration of relevant local cultural elements.

Table 1. Develop Assessment Instrument

Validity	Percentage (%)	Feasibility Criteria
Media	100	very valid
Culture	93.75	very valid
Material	98.33	very valid

The validation results showed a percentage of 100% for the media aspect, 93.75% for the cultural aspect, and 98.33% for the material aspect, all of which were in the very valid category. These findings indicate that the media developed is in accordance with the principles of developing effective learning media that are suitable for use in the context of early childhood education.

Table 2. Practicality Test of Virtual Reality Media

No	Total Score	Max Score	Percentage
1	37	40	92.5
2	37	40	92.5
Total	74	80	
Average Categories			92.5% Very Practical

The practicality of the media was shown through the results of the trial which obtained an average score of 92.5% with the category of very practical. This shows that the media is easy to use by teachers and can be implemented optimally in learning activities. This high level of practicality is in line with previous research that states that technology-based learning media that are designed interactively tend to be easier to operate and improve the efficiency of the learning process (Kandriasari et al., 2023; Putri et al., 2025). In addition, the ease of use of media also contributes to increasing children's involvement during learning (Swari et al., 2022).

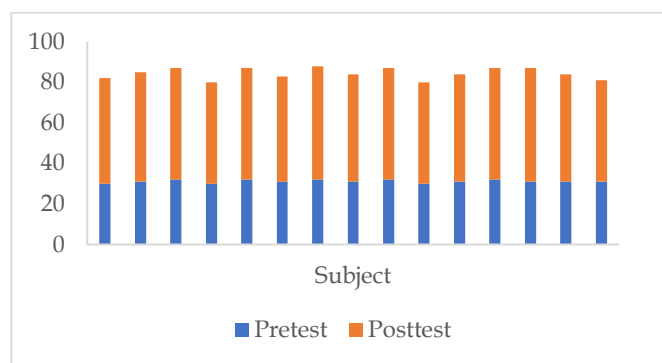


Figure 2. Large scale test pre-test post-test comparison

$$N - gain = \frac{Mean\ posttest - mean\ pretest}{Max\ Skor - mean\ pretest} \tag{1}$$

Table 3. N-gain Score

	Descriptive Statistics				
	N	Min	Max	Mean	Hours of deviation
N-gain Score	15	.66	.86	.7680	.06840
N-gain presses	15	66	86	76.80	6.840
Valid N (listwise)	15				

The effectiveness of the media was analyzed through a comparison of pretest and posttest results which showed a significant improvement in early childhood mathematics skills. The average N-Gain value of 0.768 is in the high category, which indicates that the developed media is able to provide meaningful learning improvements. The highest increase occurred in the indicators of numeracy ability and comparing measurements, which showed that the visual and interactive presentation of the material made it easier for children to understand mathematical concepts that were previously abstract. These findings are consistent with the results of research showing that the use of interactive animation media can significantly improve children's cognitive and numeracy abilities (Darmiyati et al., 2020; Rahayu et al., 2025).

The results of observations during the learning process, it was found that children showed higher levels of enthusiasm, attention, and engagement when using interactive animation video media based on local culture. Children not only play the role of recipients of information, but are also actively involved through interactions presented in the media. This supports the theory of constructivism which emphasizes that learning will be more effective When Students actively build knowledge through hands-on experience (Falloon, 2024; Kumaş, 2024). In addition, the use of visual, audio, and interactive elements in media has been proven to be able to increase children's focus and motivation to learn (Adistiarachma et al., 2025).

The integration of local culture in learning media makes a significant contribution to children's understanding of mathematics concepts. The use of cultural contexts such as lokan and rakik lokan helps children relate learning materials to everyday experiences so that learning becomes more contextual and meaningful. These findings are in line with research that states that media based on local wisdom is able to increase the relevance of learning and strengthen children's cultural identity from an early age (Afriliani et al., 2023; Salpina et al., 2024). In addition, a cultural-based contextual approach has also been shown to be effective in improving understanding of concepts and retention of children's learning (Kumaş, 2024; Safitri et al., 2025).

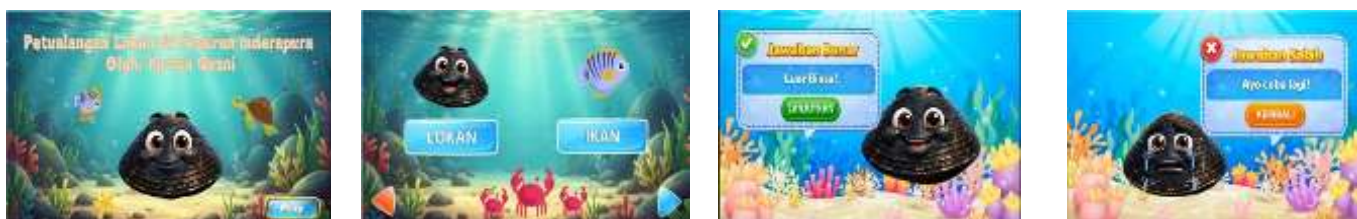


Figure 3. Opening display

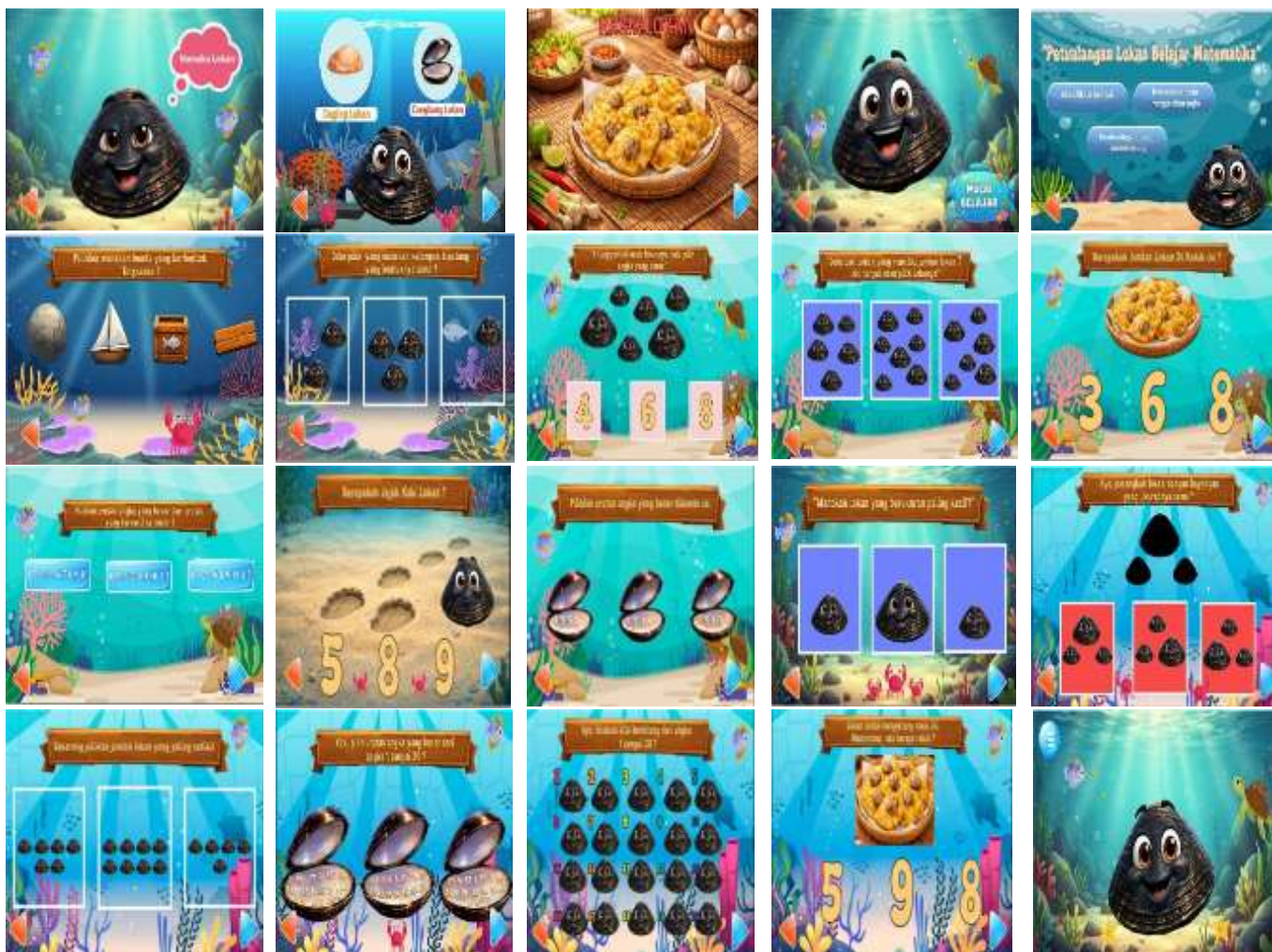


Figure 4. Interactive video media content of local culture for early mathematics

When compared to conventional learning media, the media developed in this study has advantages in terms of interactivity, visualization, and relevance of the learning context. Conventional media tends to be one-way and less able to attract children's attention, while interactive media provides a more dynamic and participatory learning experience (Kandriasari et al., 2023; Nurfadilah H et al., 2025). This strengthens the finding that technology and local culture-based learning media innovation is an effective solution to improve the quality of mathematics learning in early childhood (Falloon, 2024; Wang, 2025).

Overall, the results of this study confirm that the development of interactive animated video media based

on local culture is not only effective in improving early childhood mathematics skills, but also able to create a more interesting, contextual, and meaningful learning experience. These findings make an important contribution to the development of innovative learning media that are relevant to the needs of early childhood education in the digital era.

Conclusion

This study concludes that the development of interactive animation video media based on local culture through the ADDIE model has been proven to meet valid, practical, and effective criteria in improving early

childhood mathematics skills. Very high media validity indicates that the product has been adapted to aspects of the material, appearance, and integration of local culture, while a high level of practicality indicates ease of use in learning. In addition, the results of the effectiveness test showed a significant improvement in children's mathematical abilities as shown through the N-Gain value in the high category, especially in the counting and comparing measures indicators. These findings also show that the use of interactive media that integrates elements of local culture can increase children's involvement, motivation, and conceptual understanding through more contextual and meaningful learning. Thus, the media developed can be an innovative alternative in supporting early childhood mathematics learning and contributing to strengthening cultural identity from an early age.

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Author Contributions

KG: Research concept, media design, data collection, analysis, article writing. FM: Theory development, methodology, data analysis, article revision. RKM: Initial media design, product trial, data collection, analysis. DE: Field testing, data processing, media evaluation, writing trial results.

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Conflicts of Interest

The authors declare no conflict of interest.

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