DEVELOPMENT OF "SALIRA" INTERACTIVE VIDEO BASED ON STEAM TO ENHANCE SCIENCE AND LITERACY SKILLS IN EARLY CHILDHOOD

Ula Nur Hayatiningsih[1], Fattah Hanurawan[2], Ahmad Samawi[3], Imron Arifin[4], Pramono[5]

[1,3,4,5]Program Studi Pendidikan Anak Usia Dini FIP Universitas Negeri Malang
[2]Program Studi Psikologi Universitas Negeri Malang
[1]ulanurhayatiningsih@gmail.com, [2]fattah.hanurawan.fppsi@um.ac.id,
[3]ahmad.samawi.fip@um.ac.id, [4]imron.arifin.fip@um.ac.id, [5]pramono.fip@um.ac.id

ABSTRACT

This study stemmed from the low science and literacy skills of early childhood students at TK Muslimat NU 45 Malang, attributed to the prevalence of conventional learning methods and the lack of concrete visual media. This research aims to develop "SALIRA Interactive Video" learning media based on the STEAM (Science, Technology, Engineering, Arts, Mathematics) approach and to assess its feasibility, practicality, and effectiveness. The method employed was Research and Development (R&D) using the ADDIE model (Analysis, Design, Development, Implementation, Evaluation). The subjects of this research were all 39 students at TK Muslimat NU 45 Malang. Data were collected using expert validation sheets, practicality response questionnaires, and learning outcome tests. Validation results indicated that the product falls into the "Very Feasible" category with an average score of 90.75%. The practicality test yielded a score of 94.0%, categorized as "Very Practical." The effectiveness test results demonstrated a significant increase in the average science ability score from 54.5 to 86.0, and literacy ability from 56.0 to 88.5. It is concluded that the STEAM-based SALIRA Interactive Video is feasible and effective for enhancing early childhood science and literacy skills.

Keywords: Interactive Video, SALIRA, STEAM, Science, Literacy, Early Childhood.

A. Introduction

Childhood Education (ECE) plays a fundamental and strategic role as the initial foundation in holistically shaping a child's character, skills, and knowledge. This phase is widely recognized as the "golden age," a critical window of opportunity where brain development occurs at a pace that will not be repeated in any subsequent period of life. A comprehensive report from the Center on the Developing Child Harvard University (2021) emphasizes that rich, meaningful, and responsive learning experiences in the early years profoundly influence the formation of healthy brain architecture, particularly in cognitive, social-emotional, and language aspects. The quality of stimulation received during this period serves as a primary determinant of

their future capabilities. Therefore, the National Association for the Education of Young Children (NAEYC, 2020) strongly underscores the importance of implementing developmentally appropriate practice, defined as learning strategies meticulously designed to foster active engagement through warm social interactions, challenging exploratory activities, and the use of media relevant to the child's developmental stages.

Within the framework of early childhood cognitive development, literacy and science constitute two primary pillars. Early childhood literacy should not be reduced solely to the technical skills of reading and writing; rather, it encompasses a broader range of competencies, including comprehending information, processing meaning, and communicating effectively. On the other hand, science serves to introduce children to surrounding natural phenomena and cultivate basic scientific process skills, such as observing, questioning, predicting, and experimenting. The integration of literacy and science in learning is crucial, as the two domains complement one another in fostering critical thinking and problem-solving

capabilities. Children accustomed to scientific thinking will possess a richer vocabulary to articulate their world, while those with strong literacy skills will find it easier to grasp scientific concepts.

However, the practical implementation of science and literacy learning remains confronted by complex and multidimensional challenges. Globally, data from the World Bank et al. (2022) highlights the phenomenon of learning poverty or learning crisis, indicating that basic literacy proficiency among children in developing nations, including Indonesia, remains at an alarming level. At the national level, data from the Ministry of Education and Culture (Kemendikbud, 2023) reveals that only approximately 47% of early childhood students possess adequate basic literacy skills. Furthermore, science instruction is frequently marginalized or delivered ineffectively, with data indicating that a mere 25% of teachers actively employ exploratory approaches in teaching scientific concepts. The majority of instructional practices remain entrenched in conventional teacher-centered methods, wherein children are positioned as passive recipients of

information rather than active subjects constructing their own knowledge.

The discrepancy between ideal expectations and this reality was clearly evident in a preliminary study and observations conducted at TK Muslimat NU 45 Malang. It was found that science and literacy instruction at this institution has not been optimally integrated. Teachers frequently encounter challenges in conveying abstract subject matter due to a scarcity of instructional media capable of concretizing these concepts. Consequently, material is predominantly delivered verbally, imposing an excessive cognitive load on children and hindering their ability to visualize the instructional content. This situation culminates in low student motivation, participation, and comprehension. In the absence of engaging and contextual media, learning becomes devoid of meaning and fails to stimulate the child's natural curiosity.

This situation is further exacerbated by a contemporary challenge within the educational ecosystem known as the "digital paradox." This paradox describes a contradictory phenomenon wherein the availability of technological infrastructure and devices is exceptionally high, yet their utilization for productive educational purposes remains disproportionately low. Recent data from the Indonesian Internet Service Providers Association (APJII, 2024) indicates that internet penetration in Indonesia has reached 79.5%; however, usage is predominantly dominated by entertainment and social media. At the micro level, a study by Rahmawati (2021) identified a distinct disparity: although 70% of parents possess access to sophisticated digital devices, only 40% utilize them to support their children's learning. Similarly, while 65% of Early Childhood Education (ECE) teachers acknowledge technology as a vital instructional tool, only 30% possess the self-efficacy or technical confidence to employ it in teaching. At TK Muslimat NU 45 Malang, this paradox is evident in the presence of supporting devices that have not been optimally utilized to enhance learning quality, underscoring the necessity for media that is not only technologically advanced but also user-friendly for both teachers and parents.

To address the complexity of these issues, a strategic intervention

involving the development of innovative learning media, specifically interactive video, is required. The effectiveness of this medium is supported by strong theoretical foundations. Mayer (2014) Cognitive Theory of Multimedia Learning and Paivio (1986) Dual Coding Theory postulate that humans process information through two separate channels: visual and verbal. Learning becomes significantly more effective when both channels are activated simultaneously via video that combines audio narration with visual animation. Furthermore, Hirsh-Pasek et al. (2015) emphasize that the element of interactivity—wherein children must touch the screen, select answers, or respond to instructions—is key to creating "minds-on" (mentally active) learning. This aligns with Bandura (1977) Social Learning Theory and Observational Learning, which posit that children learn effectively through observing engaging models. Empirical evidence reinforces these theoretical grounds; a limited study conducted by Wulandari (2019) found that interactive multimedia significantly assists children in comprehending abstract scientific concepts by rendering them more concrete. Similarly, a study by Sari (2020) demonstrated that the use of interactive digital media is effective in enhancing children's reading interest and early literacy compared to conventional methods.

To optimize the learning impact, the interactive video needs to be encapsulated within a curriculum approach relevant to 21st-century challenges, namely STEAM (Science, Technology, Engineering, Arts, and Mathematics). Yakman (2008) elucidates that STEAM is not merely an aggregation of subjects, but rather an integrative framework that cultivates critical, creative, collaborative, and communicative thinking skills. Furthermore, DeJarnette (2012) notes that within the Early Childhood Education (ECE) context, STEAM provides opportunities for children to engage in learning through play via project-based activities that are relevant to their daily lives.

Despite the vast potential of STEAM-based interactive video, the literature review reveals a notable research gap. Most existing media developments tend to treat the reinforcement of literacy and science separately, or apply the STEAM

approach without adequate interactive technological support. Consequently, there remains a scarcity of media products that combine interactive video, the STEAM curriculum, and science-literacy integration into a single unified platform specifically designed for early childhood.

Proceeding from an in-depth analysis of field needs, cognitive theoretical foundations, and the identified novelty, this research focuses on the development of the "SALIRA" (Science and Literacy) Interactive Video learning media based on STEAM. This product is developed with specific specifications tailored to early childhood characteristics: colorful visual displays, communicative narration, and interactive features that invite active child engagement in solving simple problems. Through this development, it is expected to generate a valid and practical solution to bridge the gap in learning quality and address the digital paradox experienced by teachers and parents. Based on the aforementioned background, this study aims to produce a STEAM-based SALIRA Interactive Video that has been tested for feasibility and is effective in

enhancing the science and literacy skills of early childhood students at TK Muslimat NU 45 Malang.

B. Method

This study employed a Research and Development (R&D) design utilizing the ADDIE model (Analysis, Design, Development, Implementation, Evaluation). This model, developed by Branch (2009), was selected due to its systematic stages and flexible nature suitable for instructional product development. The primary objective of this research was to produce the "SALIRA" (Science and Literacy) Interactive Video learning media based on the STEAM approach, which has been tested for both feasibility and effectiveness.
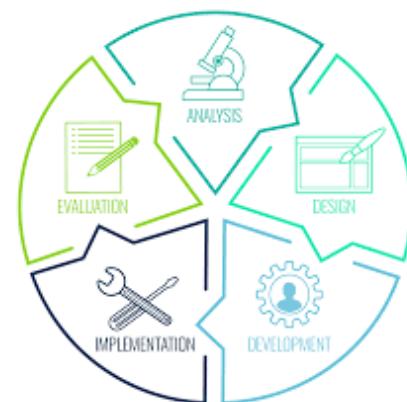

Figure 1. ADDIE Model Product Development Stages

The development procedure commenced with the analysis phase,

which encompassed teacher needs analysis, analysis of early childhood developmental characteristics, and curriculum analysis at TK Muslimat NU 45 Malang. The second phase was design, wherein the researcher formulated the product design, including the creation of a video storyboard integrating STEAM components, the selection of visual and audio assets, and the design of a user guidebook for teachers and parents. The third phase was development, representing the process of realizing the design into a tangible interactive video product. In this phase, validation was performed by three categories of experts: (1) Media experts to assess visual, audio, and interactivity aspects; (2) Material experts to evaluate content alignment with the curriculum and STEAM principles; and (3) Educational practitioners (teachers) to assess practicality. Upon validation, the subsequent phase was implementation, carried out through two trial schemes at TK Muslimat NU 45 Malang. First, a small-group trial involving 6 children was conducted to identify initial technical constraints. Second, a large-group trial involving all students in one class was

conducted to observe the effectiveness of the media usage in a classical setting. The final phase was evaluation, which was conducted formatively at every stage for product refinement, and summatively through learning outcome tests.

The subjects of this study were students at TK Muslimat NU 45 Malang. Data collection techniques employed both non-test and test instruments. The non-test instruments included expert validation questionnaires, teacher response questionnaires, interview guidelines, and observation sheets for child activities. Meanwhile, test instruments were utilized to measure improvements in children's science and literacy skills using a pre-test and post-test design. Data analysis was conducted using descriptive qualitative and quantitative techniques. Qualitative data, in the form of critiques and suggestions from validators, were analyzed to serve as a reference for product revision. Quantitative data from the validation questionnaires were analyzed using a Likert scale (1-5), which was then converted into a feasibility percentage. The formula for the Likert Scale method used to calculate the

questionnaire percentage results is presented below. This formula has been adapted with modifications to the variables and question items used in this study. The product was deemed feasible if the achievement percentage reached a minimum of ≥61% ("Good" category). Furthermore, effectiveness data were analyzed by comparing the average scores of children's science and literacy skills before and after the use of the SALIRA interactive video media.

C. Result And Discussion

The in-depth needs analysis phase conducted at TK Muslimat NU 45 Malang revealed fundamental facts regarding gaps in the instructional process. Observations involving 39 students indicated that teachers predominantly relied on static media, such as printed images and magazines, to deliver science content. Although a small fraction of the children appeared attentive, the majority exhibited passive behavior, were easily distracted, and appeared disengaged. This condition is attributed to the lack of multisensory stimulation; static imagery is incapable of visualizing dynamic scientific processes (such as color changes or growth), rendering the material abstract and difficult for children's cognition to grasp. Furthermore, the learning dynamics were heavily reliant on the completion of Student Worksheets, characterized by a rigid instructional nature. Children were merely required to trace letters or color according to the teacher's instructions, with no room for exploration. This condition was identified as hindering the development of children's creativity and critical reasoning, as they were not afforded the opportunity to express ideas, ask questions, or conduct simple experiments. Science and literacy instruction proceeded in a fragmented and unidirectional manner, making the urgency to introduce media that integrates both aspects interactively and enjoyably a pressing necessity.

Based on observations and interviews conducted with class teachers at TK Muslimat NU 45 Malang, it was identified that the children's science and literacy skills remain low. Teachers reported that the majority of children struggle to visualize abstract scientific concepts and possess a limited vocabulary when recounting observed phenomena. The learning process, dominated by conventional

(teacher-centered) methods and a scarcity of visual media, has resulted in low student enthusiasm. Initial measurement data (pre-test) indicated that the majority of children fall into the "Starting to Develop" (Mulai Berkembang or MB) category. The distribution of the children's initial capability scores is presented in Table 1.

Table 1. Distribution of Children's Initial Capability Scores (Pre-Test)

No	Achievement Category	Frequency	%
1	Not Yet Developed (NYD)	10	26%
2	Starting to Develop (SD)	23	59%
3	Developing as Expected (DE)	6	15%
4	Developing Very Well (DVW)	0	0%
Total		39	100%

Based on the data presented in Table 1, it can be observed that the initial science and literacy capabilities of the students are generally not yet optimal. The majority of students, specifically 23 children (59%), are merely at the "Starting to Develop" (SD) stage. Furthermore, a significant proportion, namely 10 children (26%), remain at the "Not Yet Developed" (NYD) stage. Only a small fraction of students, 6 children (15%), have reached the "Developing as Expected" (DE) stage, and none (0%) have achieved the "Developing Very Well" (DVW) stage. Cumulatively, the percentage of children who have not yet reached mastery (categories NYD and SD) amounts to 85%. This high figure indicates that the current instructional stimulation has not been effective in developing children's science and literacy competencies, thereby making the development of the "SALIRA Interactive Video" media an urgent necessity. This finding aligns with the analysis by Wulandari (2019), who asserts that verbal methods without multimedia support impose an excessive cognitive load on early childhood students, rendering the material difficult to comprehend.

In response to the findings from the analysis phase, the design phase focused on creating media capable of accommodating the visual and kinesthetic (learning by doing) learning styles of early childhood. The researcher designed the "SALIRA" Interactive Video with reference to the STEAM-based curriculum. In this phase, the researcher established the instructional objectives of the video to transform abstract scientific concepts

into concrete forms through 3D animation visualization.

The design process commenced with the development of a storyboard that integrates literacy narratives (storytelling) with specific STEAM activities, namely: Science through color mixing experiment simulations; Technology through the use of microscopes to observe insects; Engineering through building block construction challenges; Arts through collage creation activities; and Mathematics & Literacy through animal name recognition and counting operations. Unlike conventional videos, this design utilizes a non-linear progression by incorporating a "pause-and-prompt" feature, wherein the video is programmed to pause momentarily to present prompting questions or interactive quizzes. The main characters, "Sali and Rara," were designed as peer models to foster emotional engagement with the children. From a technical perspective, this design integrates text elements, clear audio narration, atmospheric background music, and motion animation into a unified digital platform accessible via laptops or mobile devices, thereby ensuring flexibility for implementation in both classroom and home settings.

The "pause-and-prompt" feature, coupled with the presence of characters Sali and Rara, encourages children to engage actively, as if they were role-playing as science explorers. This approach aligns with the findings of Siahaan et al. (2024), who state that active learning methods, such as the implementation of role-playing, are highly effective in stimulating the development of children aged 5-6 years. Although that study focused on fine motor skills at KidZania, the underlying principle is consistent with the SALIRA Video: children learn best when they are actively involved in play scenarios rather than merely serving as passive spectators. This interactivity fosters high enthusiasm and sustains children's focus throughout the learning process.

The subsequent phase was development, which constituted the process of transforming the storyboard design into a tangible product: a High Definition (HD) 3D animated video. The production process entailed the integration of visual assets, the recording of audio narration, and the construction of

simple programming logic for interactive features. This development adhered to the principles of developmentally appropriate practice, wherein contrasting color compositions and contextual elements were tailored to the perceptual psychology of early childhood. The main characters, "Sali and Rara," were introduced as peer models to accompany children in exploring scientific phenomena. The primary strength of this product lies in the concrete visualization of the material, where STEAM concepts are not presented as rote memorization but are instead integrated within the characters' activities. The visualization of the SALIRA video interface is presented in Figure 1.

Figure 1. Visualization of STEAM Content in the SALIRA Video

The visual display illustrates the integration of learning elements through: (a) a color mixing experiment activity that incorporates Science and Art elements; and (b) the utilization of a microscope (Technology) and map reading, which fosters literacy and Engineering skills. All activities are encapsulated within an adventure narrative to stimulate curiosity and enrich children's scientific vocabulary in a contextual manner.

Following the development of the product draft, the product quality was assessed through validation by media experts and material experts. A recapitulation of the validation results is presented in Table 2.

Validator	Key Assessment Aspects	%	Category
Media Expert	Visual Quality, Audio, Typography, Interactivity	92,5%	Very Feasible
Material Expert	Curriculum Alignment, Accuracy of Scientific Concepts, Language	89%	Very Feasible
Average		90,75%	Very Feasible

Based on the data presented in Table 2, the SALIRA Interactive Video achieved an average validity score of 90.75%, placing it in the "Very Feasible" category. This average score demonstrates that the SALIRA Video successfully transforms abstract scientific material into concrete forms. This achievement is underpinned by the application of the principles of the Cognitive Theory of Multimedia Learning (Mayer, 2014), wherein the combination of verbal narration and visual animation has been proven effective in enhancing children's memory retention. Furthermore, the design of the characters "Sali and Rara" as peer models is considered effective in fostering emotional engagement, thereby triggering the Social Learning process (Bandura, 1977), in which children are more motivated to learn by emulating peer characters.

Nevertheless, refinements were still undertaken. Revisions were executed based on the directives received; consequently, the material expert validation yielded a percentage of 89.0%. Constructive feedback from the material expert focused on simplifying instructional language to enhance comprehensibility for children. Concurrently, the media expert provided input for revision, specifically suggesting the addition of sound effects and the improvement of the narrator's intonation by utilizing a more enthusiastic tone to prevent student boredom. The media expert validity assessment resulted in a score of 92.5%. Based on the assessment results from both material and media experts, and referencing the guidelines for converting quantitative data into qualitative criteria, the SALIRA Interactive Video is categorized as valid and very feasible for implementation.

The subsequent phase was implementation, conducted after the STEAM-based SALIRA Interactive Video designed to enhance early childhood science and literacy skills had been developed and validated by experts. The application of this video was pilot-tested in a small-scale trial involving six students from TK Muslimat NU 45 Malang. During the teaching and learning activities, students utilized the SALIRA video under teacher guidance to observe the media's response in fostering enthusiasm and material comprehension. The results of the

small-scale trial are presented in Table 3 below.

Table 3. Small-Scale Trial Result

School	Respond	Average	Category
TK Muslimat NU 45	6	82,5%	Very Interesting

The small-scale trial conducted at TK Muslimat NU 45 Malang, involving six respondents, yielded an assessment score of 82.5%, falling into the "Very Interesting" category. Although the media was rated highly in quantitative terms, based on field observation notes, the researcher undertook minor refinements regarding technical audio aspects and the clarity of instructions. These revisions were implemented to optimize the media for use in a classical setting. Thus, it can be concluded that this media product is feasible to proceed to the large-scale trial phase.

The large-scale trial was conducted on a whole class comprising 39 respondents at TK Muslimat NU 45 Malang. The number of respondents corresponded to the total student population of the class where the research was undertaken. The results of the large-scale trial are presented in Table 4 as follows.

Table 4. Large-Scale Trial Results

School	Respond	Average	Category
TK Muslimat NU 45	39	94%	Very Interesting

Based on Table 4, the large-scale trial yielded an average score of 94.0%, falling into the "Very Interesting" category. This achievement indicates that the SALIRA Interactive Video elicited a highly positive response and is feasible for widespread implementation as an instructional medium in Kindergartens.

The comparison of data between the small-scale and large-scale trials demonstrates a significant trend in product quality improvement. Quantitatively, there was an increase in assessment scores from 82.5% (small-scale) to 94.0% (large-scale). This improvement indicates that the revisions implemented on audio and instructional aspects successfully refined the product's maturity. This finding is corroborated by qualitative observations in the field, wherein children exhibited significantly greater enthusiasm, actively responded to interactive features, and remained focused on the "Sali and Rara" storyline until the conclusion of the

lesson, compared to the initial trial phase. The large-scale trial conducted at TK Muslimat NU 45 Malang with 39 respondents yielded a score of 94.0%, falling into the "Very Interesting" category. Consequently, it can be concluded that the developed media elicited a highly positive response and is feasible for widespread utilization as an instructional medium in Kindergartens.

The final phase was evaluation, aimed at conducting a comprehensive assessment of the product's quality in terms of practicality and effectiveness to ensure the SALIRA Interactive Video meets user requirements. Media Practicality Practicality evaluation was conducted based on user responses. The practicality test by teachers yielded an average score of 94.0%, categorized as "Very Practical." Interview data corroborated this finding, wherein teachers stated that the media interface is intuitive (user-friendly), thereby facilitating operation in the classroom. This high score addresses the "digital paradox" challenge (Rahmawati, 2021), demonstrating that the SALIRA Video serves as a practical solution (scaffolding) for teachers to implement STEAM learning without complex technical barriers. This aligns with the findings of Astuti et al. (2023) in Malang City, which indicate that teachers require easy-to-use media to support the implementation of a curriculum demanding critical thinking. Furthermore, the use of the SALIRA Video proved effective in transforming the classroom atmosphere from rigid to fluid and enjoyable. This is relevant to Hanurawan (2012) perspective regarding strategies for developing mental health in school environments, where the creation of a positive and low-pressure learning atmosphere is crucial for student well-being. By utilizing engaging and non-monotonous media, children are spared from stress caused by excessive academic demands (such as completing numerous worksheets), allowing them to learn science with a sense of joy and comfort.

Media effectiveness was analyzed using a pre-test and post-test design. Data regarding the improvement of science and literacy skills are presented in Table 5.

Table 5. Improvement of Children's Science and Literacy Skills

Skill Aspect	Score Pre Test	Post test	Gain	Achievement Category
Science	54.5	86.0	31.5	High

Literacy	56.0	88.5	32.5	High

Based on the data in Table 5, the analysis reveals a substantial improvement in achievement. The average score for Science skills increased by 31.5 points (rising from 54.5 to 86.0), whereas Literacy skills increased by 32.5 points (rising from 56.0 to 88.5). This significant surge in scores, classified within the "High" category, demonstrates that the STEAM approach, when holistically integrated into the video, is significantly more effective than fragmented instruction.

The interpretation of the evaluation results regarding the effectiveness of the SALIRA video in boosting learning outcomes can be elucidated through the synergy between cognitive theory and instructional design. First, from a cognitive perspective, this success corroborates Mayer (2014) theory of multimedia learning and Bandura (1977) theory of observational learning. The characters "Sali and Rara," serving as peer models, successfully assisted children in observing and emulating scientific processes (such as color mixing), transforming them into concrete experiences. This aligns with the findings of Wulandari (2019), who asserted that multimedia technology is effective in visualizing abstract scientific concepts into tangible realities. Second, regarding content integration, this finding reinforces the research of Handayani (2022) and Permata & Lestari (2021), which states that STEAM activities are effective in stimulating critical thinking skills and creating holistic learning experiences. Literacy improvement occurred because children were not merely watching but were also encouraged to comprehend instructions and acquire new vocabulary (such as "microscope" or "map") within the narrative context. This is consistent with Nuryani (2021) and Sari (2020), who found that participatory digital media is capable of significantly enhancing early literacy. Third, the interactivity factor. The "pause-and-prompt" feature proved effective in sustaining high levels of child attention (engagement), in contrast to conventional passive videos. This approach corresponds to the definition of STEAM by Yakman (2008), which requires active student involvement in problem-solving.

Nevertheless, the utilization of the SALIRA Interactive Video presents

specific challenges, such as reliance on adequate hardware (laptops or mobile devices) and a conducive classroom audio environment. Teachers are also required to play an active role in facilitating instruction, for instance, by utilizing the pause function when the video presents prompting questions, thereby affording children the necessary time to reflect and respond. Despite these constraints, the primary advantage of this media lies in its capability to visualize complex scientific concepts into simplified and concrete forms tailored to the children's stage of cognitive development, as well as fostering learning enthusiasm through a participatory narrative structure.

D. Conclusion

Based on the research and development undertaken, it is concluded that the STEAM-based "SALIRA" (Science and Literacy) Interactive Video has been successfully developed and proven to be highly feasible, practical, and effective for use in early childhood education. Validation by material and media experts confirms that the product meets the quality standards for instructional media, while positive feedback from teachers at TK Muslimat NU 45 Malang indicates that the media is user-friendly and assists in visualizing abstract concepts. In terms of effectiveness, the product implementation demonstrated a significant improvement in children's science and literacy skills, evidenced by a marked leap in learning achievement from the "Starting to Develop" category to "Developing Very Well." Therefore, this media is recommended to early childhood educators as an innovative solution to stimulate contextual active learning, and it is suggested that future researchers expand the scope of development to include other learning themes.

References

APJII. (2024). *Survei Profil Internet Indonesia 2024*. Asosiasi Penyelenggara Jasa Internet Indonesia.

Astuti, W., Muna, F. A. N., Sutama, I. W., & Samawi, A. (2023). Understanding Of Early Childhood Education Teachers In Malang Cityabout The Implementation Of The Merdeka Curriculum At The Paud Level. *Proceeding of International Conference on Multidisciplinary Research*, 1(1), 207–223.

Bandura, A. (1977). *Social Learning Theory*. Prentice-Hall.

Bank, W., UNESCO, & UNICEF. (2022). *The State of Global*

Learning Poverty: 2022 Update. The World Bank.

Branch, R. M. (2009). *Instructional Design: The ADDIE Approach*. Springer.

DeJarnette, N. (2012). America's children: Providing early exposure to STEM (science, technology, engineering and math) initiatives. *Education*, *133*(1), 77–84.

Handayani, S. (2022). Implementasi Pendekatan STEAM dalam Pembelajaran PAUD untuk Meningkatkan Berpikir Kritis. *Jurnal Pendidikan Anak Usia Dini*, *6*(2), 98–110.

Hanurawan, F. (2012). Strategi Pengembangan Kesehatan Mental di Lingkungan Sekolah. *PSIKOPEDAGOGIA Jurnal Bimbingan Dan Konseling*, *1*(1).

Hirsh-Pasek, K., Zosh, J. M., Golinkoff, R. M., Gray, J. H., Robb, M. B., & Kaufman, J. (2015). Putting Education in "Educational" Apps: Lessons From the Science of Learning. *Psychological Science in the Public Interest*, *16*(1), 3–34.

Kebudayaan, K. P. dan. (2023). *Laporan Kinerja Kementerian Pendidikan dan Kebudayaan Tahun 2023*. Kemendikbud.

Mayer, R. E. (2014). *The Cambridge Handbook of Multimedia Learning* (2nd (ed.)). Cambridge University Press.

NAEYC. (2020). *Developmentally Appropriate Practice (DAP) Position Statement*. National Association for the Education of Young Children.

Nuryani, R. (2021). Pengembangan Media Video Interaktif untuk Meningkatkan Partisipasi Belajar Anak Usia Dini. *Jurnal Teknodik*, *25*(1), 33–45.

Paivio, A. (1986). *Mental Representations: A Dual Coding Approach*. Oxford University Press.

Permata, A., & Lestari, B. (2021). Integrasi STEAM melalui Media Pembelajaran Digital di Taman Kanak-Kanak. *Jurnal Pendidikan Awal Kanak-Kanak Kebangsaan*, *10*(1), 55–67.

Rahmawati, A. (2021). Paradoks Digital: Kesenjangan Akses dan Pemanfaatan Teknologi oleh Guru PAUD di Era Pandemi. *Jurnal Obsesi: Jurnal Pendidikan Anak Usia Dini*, *5*(2), 1200–1210.

Sari, M. (2020). Penerapan Media Digital Interaktif untuk Meningkatkan Literasi Dini Anak. *Jurnal Ilmiah Potensia*, *5*(1), 20–29.

Siahaan, G. H. T., Samawi, A., & Tirtaningsih, M. T. (2024). Implementasi Role Playing Perancang Perhiasan Sebagai Stimulasi Perkembangan Motorik Halus Anak Usia 5-6 Tahun Di Kidzania Surabaya. *Dharmas Education Journal (DE_Journal)*, *5*(2), 907–916.

University, C. on the D. C. at H. (2021). *Moving Upstream: Confronting Racism to Open Up Children's Potential*. Harvard University.

Wulandari, T. (2019). Pengaruh Multimedia Interaktif terhadap Kemampuan Sains Anak Usia Dini. *Jurnal Pendidikan IPA Indonesia*, *8*(1), 112–120.

Yakman, G. (2008). STEAM Education: An Overview of Creating a Model of Integrative Education. *PATT-19 Conference: Pupils Attitude Towards Technology*.