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Development of E-Book Learning Media in Introducing Science for Early Childhood

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Abstract
The issue of science knowledge comprehension among early childhood children is a complex matter that requires serious attention in many countries, including Indonesia. Several studies indicate that the understanding of science knowledge among early childhood children in Indonesia is still relatively low. One of the efforts to provide a solution to these issues is the development of electronic book (e-book) instructional media. This development research employs the ADDIE model. The ADDIE model's developmental stages include analysis, design, development, implementation, and evaluation. The target audience is Kindergarten Group B children aged 5-6 years from TK Lab.School IKIP PGRI Jember. The instruments used for this research are expert media review, expert design review, expert content review, responses from small and large focus groups. Based on the response results, the understanding of participants reached 90,6%, the appeal was rated at 90,4%, with an overall average of 90,5%. The e-book's development results, based on the participants' responses, indicate that the usage of the e-book is highly suitable and effective in enhancing the understanding of science among children aged 5-6 years.

Keywords: *e-book learning media; science knowledge; early childhood*

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Introduction
Quality Early Childhood Education provision is one of the needs and priority plans of the Ministry of Education and Culture, especially the Directorate General of Early Childhood Education and Community Education. Quality Early Childhood Education provision is demonstrated by its ability to tailor education delivery while considering institutional needs, characteristics, and the challenges facing Indonesia now and in the future (BAHAR & AKSÜT, 2020).

Learning for children in Group B (aged 5-6 years) involves aspects of cognitive development, including science education (Pertiwi et al., 2022). The cognitive abilities of 5-6-year-old children include understanding numbers, enabling them to identify numerical figures; problem-solving in their daily lives; comprehending logical situations and outcomes; and engaging in exploratory and investigative (Febiharsa & Djuniadi, 2018).

The development of technology and the digital age's progress, where everything is digitally driven, places demands on teachers to be more innovative in developing learning media in this digital era (Satriana et al., 2022). However, some teachers still underutilize effective, creative, and innovative media development in learning to enhance scientific

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knowledge for use in educational activities, leading to monotonous and unengaging teaching (Khofifah et al., 2023).

Research on developing educational media for early childhood has been carried out by several researchers (Kirana et al., 2022)(Friwahyuni et al., 2022). Previous studies on e-book media for early childhood have also been conducted (Asmawati & Hidayat, 2020), but science teaching material is still limited to storybook media, whereas science concepts should be accessible to children from an early age. In this regard, there is a need for the development of learning media that supports science education for children, especially focusing on the environment-related life sciences (Sari & Linda, 2021).

In connection with this, there is a need for the development of media that supports science education for children, especially concerning environmental life sciences (Jumiati et al., 2022) (Nurjanah & Mukarromah, 2021). The development of ADDIE model e-book media is carried out with the aim of serving as an alternative for introducing science (Novalić et al., 2021). The use of the ADDIE model in this research is because the ADDIE model provides a systematic and structured framework for developing effective and relevant e-book learning media.

The State of the Art of previous research on the development of e-book learning media has been widely conducted (Egert et al., 2022) (Nurhikmah et al., 2021)(Korat et al., 2022). However, the innovation of this study lies in its heightened focus on the development of an e-book for presenting science content in a manner that is more easily understandable by early childhood education students, specifically targeting children aged 5-6 years in Kindergarten Group B. By utilizing e-books in science education, children can grasp scientific concepts from an early age, nurturing their interest and creativity in the realm of science. The novelty of this e-book learning media development research also includes various interactive features that enhance children's engagement in the learning process, ultimately increasing their accessibility to scientific materials. In e-book format, scientific materials can be easily accessed by children from anywhere and at any time. Therefore, the development of e-book learning media in this research possesses distinct characteristics that set it apart from previous studies.

Method

The development of E-book research utilizes the ADDIE model. The ADDIE model comprises five stages: analysis, design, development, implementation, and evaluation, as illustrated in the following **figure 1** (Sugihartini & Yudiana, 2018)(Latip, 2022).

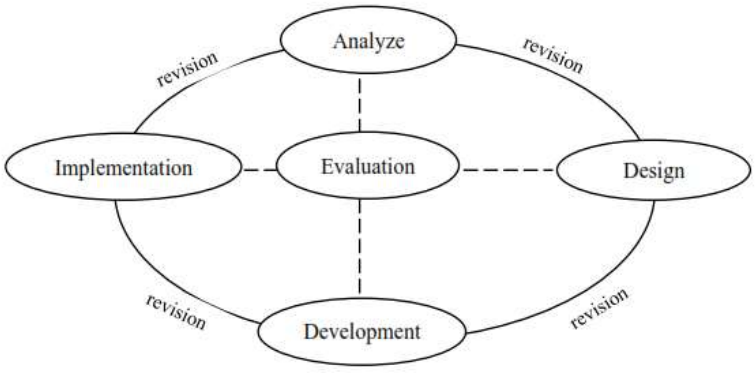

Figure 1. Research on the Development of the ADDIE Model

The ADDIE model framework in **Figure 1** encompasses multiple stages for executing the development of the ADDIE model, as outlined in the concept (Fitriyah et al., 2021) explained below:

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Analysis; The analysis conducted by the researcher includes: 1) Analyzing initial student conditions; 2) Reviewing literature; and 3) Determining the e-book media to be developed. Design; Validate media performance, structure, objectives, strategies, and methods accordingly. Development; Creating learning objects, such as text documents, animations, images, recordings, videos, and generating additional supporting documents, Validating the developed e-book learning media products. Implementation; Implementing learning using the developed e-books by preparing a learning environment, teachers, and students. Evaluation; The ADDIE model is remarkably user-friendly when used as a foundation or guide for product development, as its intention is to provide an efficient and intuitive approach to product development. the ADDIE model is a direct system that proves beneficial in materializing planning, wherein cycles can be applied within varying contexts due to its general design (Rustandi & Rismayanti, 2021). The stages are outlined as follows:

Analysis is the initial stage that must be undertaken. The steps taken by the researcher are as follows: 1) Analyzing the students; 2) Determining teaching materials; 3) Establishing the competency standards to be achieved; and 4) Choosing the media to be used, namely e-book (Fitriyah et al., 2021).

Design, involves planning based on what has been formulated in the analysis stage, which includes searching for syllabi related to the content, selecting competency standards, defining learning objectives, success indicators, learning resources, implementing teaching methodologies, and designing inter-page connections (Latip, 2022).

Development, which represents the production stage where everything formulated in the planning stage comes to life. Activities in this phase encompass creating learning objects, such as text documents, animations, images, recordings, videos, and generating additional supporting documents (Fitriyah et al., 2021).

Implementation is the tangible step of executing the learning system we have created. This means that in this stage, everything that has been developed, introduced, or organized is arranged according to its role or function, so that it can be put into practice. At this stage, the learning media is suitable for use by the students (Rustandi & Rismayanti, 2021).

Evaluation can be conducted in two forms: formative and summative evaluations. Formative evaluation is carried out during and between the stages described above. The purpose of this evaluation is to further develop the learning system that was created before the final stage is implemented. Summative evaluation is performed after the final version has been implemented and is intended to assess the overall effectiveness of the learning process (Sugihartini & Yudiana, 2018).

The target audience is the children of Group B in a kindergarten, aged 5 to 6 years old, at the Lab School of IKIP PGRI Jember. The research variables include e-book media, e-book design, e-book content/material, effectiveness, and attractiveness of the learning process. The instruments employed are media expert review, design expert validation, content/material expert assessment, as well as feedback from small and large groups.

The data analysis technique used in the validation stage of the research is the analysis of the validity level of the developed media through the examination of validation sheets by three experts. The percentage of validation data is obtained through Likert scale calculations in accordance with **Table 1** (Fitriyah et al., 2021).

Table 1. Likert Scale

Score	Criteria
5	Very good
4	Good
3	Enaough
2	Bad
1	Very bad

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the obtained scores are then summed up. The formula used to obtain the percentage is:

$$\text{Percentage} = \frac{\text{Total Score for the Criteria of Pendulum Experiment Data}}{\text{Criteria Score}} \times 100\%$$

Note:

- The total score for the data collection criteria is the sum of all validated aspects.
- Criterion Score is the highest score multiplied by the number of aspects validated. Once the percentage is determined, validation criteria are then applied, as shown in **table 2.**

Table 2. Validation Criteria (Fitriyah et al., 2021)

Percentage (%)	Criteria
0-20	very invalid
21-40	less valid
41-60	enaough
61-80	valid
81-100	very valid

Based on these criteria, the instructional media is considered valid when all aspects in the questionnaire receive a percentage of ≥61% with the criteria of valid and very valid.

The analysis of student responses is conducted directly through a questionnaire provided to the students' parents, as the students themselves, aged 5-6 years old, are not capable of completing and reading the questionnaire. Therefore, the questionnaire is filled out by the students' parents.

Result and Discussions

The research is conducted through the stages of the ADDIE model, which are as follows:

Analysis

The researcher conducted a preliminary analysis, which involved analyzing the Core Competencies, Basic Competencies, and learning objectives in alignment with the curriculum used at Lab.School IKIP PGRI Jember.

The analysis of students, the subjects of this study, involved students from Lab School IKIP PGRI Jember who can comprehend science learning in a unique manner. They use e-books to observe instructional videos and then proceed to practice hands-on science exploration. The parents of these students are generally capable of supporting their children's introduction to science through technology, such as smartphones, computers, and laptops, as they mostly possess these facilities. In another sense, the textbooks used by the school are the primary learning resources, while these e-books serve as supplementary learning materials.

Design

The process began with formulating an activity program for the development of the e-book media using the Book Creator application, accessible through https://s.id/E-BookSains-AUD . Supporting tools for creating the e-book included the Lesson Preparation Plan, Powtoon for generating animated images, storybooks or children's books, and YouTube videos. Additionally, expert surveys and revisions were conducted for media, design, and content. The initial interface of the e-book media in the Book Creator application, designed by the researcher, can be seen in **Figure 2.**https://s.id/E-BookSains-AUD

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Figure 2. E-Book Opening Display

When users operate this e-book media, the initial display they will encounter is a menu option as shown in **Figure 2**. In **Figure 2**, the e-book title and the "Read now" text are positioned at the bottom right. To continue reading the e-book, click on the "Read now" text, which will then bring up a display as seen in **Figure 3**.

Figure 3. The design of the developed e-book cover.

The e-book interface consists of an opening, main content, and closing sections. The content of the e-book serves as a support for the science introduction process, enhanced with audio and YouTube videos, which can be viewed from slide Four onwards.

Figure 4. Slide 4 features an instructional video explaining the process of rainfall.

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In **Figure 4**, there is an illustrated story about the process of rainfall, accompanied by an instructional video, which can be viewed on slide four of the e-book.

Figure 5. Slide 5 is presented with the stages of the process of rain accompanied by Audio

In **Figure 5**, there is an illustration of the process of rainfall accompanied by audio, which can be viewed on slide five of the e-book.

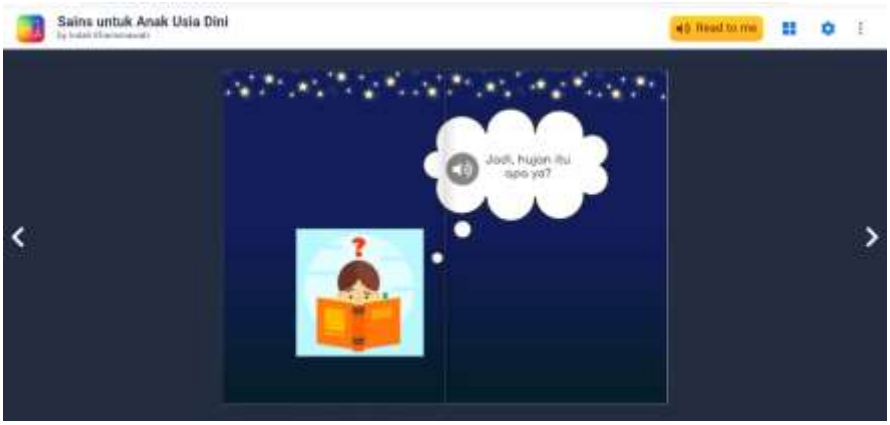

Figure 6. Evaluation for students

In **Figure 6**, the student evaluation involves retelling, based on each student's understanding, the process of rainfall after completing the sub-theme lesson on water, specifically the process of rainfall presented on slides four and five.

Development

The researcher conducted an examination and revision of the e-book with media experts, and the results are as **table 3**. Based on **Table 3**, the assessment results from expert media validators indicate that the components of the e-book media have met the criteria for instructional media with a percentage of 94.28%. This signifies that the e-book media is suitable for use and capable of enhancing the appeal in teaching science at TK Lab.School IKIP PGRI Jember.

Based on **Table 4**, the expert assessment results provide evaluations of the e-book design in terms of attractiveness, appearance, and effectiveness. The design experts conveyed that the e-book medium is highly appealing for use due to its alignment with the foundational learning principles for kindergarten children, with a percentage of 96.92%.

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Table 3. The Expert Media Assessment Results

No	Assessment Aspects	Deskription	Assessment	Category
1	Appearance or Display	- Cover Design	5	Very good
		- Attractive color combination in the e-book learning media	5	Very good
		- Precision of illustrations matching the content	5	Very good
		- Suitability of images for content clarity	4	Good
		- Unique and engaging interaction and animation within the application	4	Good
		- Clear and understandable presentation of content in the e-book learning media	5	Very good
		- Appropriate font size selection in the e-book learning media is clear	5	Very good
2	Learning	- Media presented aligns with the content	5	Very good
		- Systematic presentation of content	4	Good
		- E-book learning media can be used as an alternative for both online and offline learning	5	Very good
		- E-book learning media aligns with the science concept	5	Very good
3	Attractiveness	- E-book learning media encourages interaction between children, teachers, and parents	5	Very good
		- E-book learning media stimulates children's curiosity	5	Very good
		- The appearance of the e-book learning media enhances children's learning interest	4	Good
		Total Score	66	
		Percentage = $\frac{66}{70}$ x 100% = 94,28%		Very good

Table 4. The Design Expert Evaluation Results

No	Assessment Aspects	Deskription	Assessment	Category
1	Attraction	- Media design in accordance with the raised theme	5	Very good
		- Media design aligns with the concept of early childhood learning through play	5	Very good
		- Media tailored to the integration of 5 to 6-year-olds with a unique concept	5	Very good
		- Engaging media design	4	Good
		- Media design provides real-life examples.	5	Very good
		- Media design presents science.	5	Very good
2	Appearance or Display	- The presented media is in line with the content	5	Very good
		- The presentation of the material is done systematically	5	Good
		- The media can be used as an alternative for both online and offline learning	5	Very good
		- The media aligns with the concept of science	5	Very good
3	Effectiveness	- The media has an attractive and easily portable/displayable appearance	5	Very good
		- Provided with a title/caption for the media	5	Very good
		- The presentation of the media is capable of enhancing students' learning interests.	4	Good
		Total Score	63	
		Persentase = $\frac{63}{65}$ x 100% = 96,92%		Very good

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Table 5. The Expert Content Assessment Results

No	Assessment Aspects	Deskription	Assessment	Category
1	The Relevance of Learning Materials	- The material is relevant to basic competencies and learning indicators	5	Very good
		- The content is relevant to the theme of early childhood learning	5	Very good
		- The completeness of the learning material is in line with the developmental level of the children	4	Good
		- The illustrations in the learning media are appropriate for the children's developmental stage.	5	Very good
		- The learning media illustrations are sufficiently functional	4	Good
2	Effectiveness	- The presented learning materials are in accordance with the development of early childhood	5	Very good
		- The presented learning materials are in line with daily life	5	Very good
		- The packaging of learning materials in e-book media is in accordance with the scientific approach	5	Very good
3	Presentation Completeness	- Presenting the competencies that should be mastered by the children	5	Very good
4	Fundamental concepts of the material	- Alignment with scientific concepts	5	Very good
5	Alignment with scientific concepts	- Fostering children's curiosity	5	Very good
		- Encouraging interactions between children, parents, and teachers	4	Good
		- Stimulating children to build their own knowledge	5	Very good
		Total Score	62	
		Precentage = $\frac{62}{65}$ x 100% = 95,38%		Very good

Based on **Table 5**, the expert assessment results indicate that the created e-book media has met the qualification standards with a percentage of 95.38%. This implies that the e-book media is highly suitable for use due to its depiction of Core Competencies, Basic Competencies, and learning objectives, accuracy of content, supporting learning materials, and assessment stages that align with the developmental level of early childhood.

Implementation

After the e-book was reviewed, revised, and validated, it was implemented in the learning process for a trial. The theme was natural phenomena, with the sub-theme being the process of rainfall. Students were provided with an explanation of the natural phenomenon of the rainfall process. They told stories using the e-book, which was accompanied by instructional videos based on YouTube as complementary media for the e-book. Through the e-book and videos, students could learn about the science behind the process of rainfall, color mixing, and could practice these concepts on their own according to their imagination.

Evaluation

The students were given a response questionnaire through their parents because the students, aged 5 to 6 years old, on average, are not yet able to read. Therefore, parents assisted the students in completing the questionnaire.

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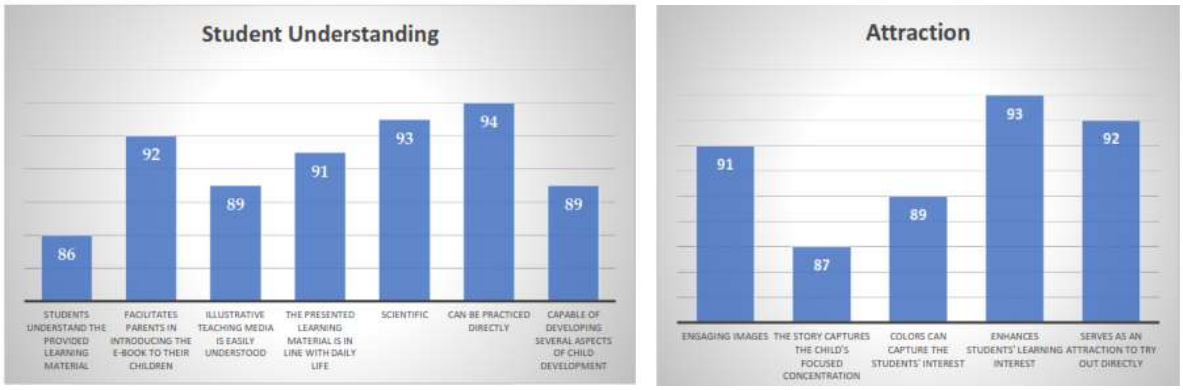

Figure 7. Results of Student Response Questionnaire According to Criteria

In **Figure 7**, the results of the student response questionnaire can be observed as follows: Students understand the provided material by 86%. It facilitates parents in introducing storybooks to children by 92%. The illustrative media is easily comprehensible by 89%. The provided material aligns with daily life by 91%. It is scientific by 93%. It can be practiced directly by 94%. It is capable of developing several aspects of child development by 89%. The images are appealing by 91%. The story captures the child's concentration by 87%. Colors are able to capture the students' interest by 89%. It enhances students' learning interest by 93%. And it holds an appeal for experimentation by 92%. This means that the students' understanding of the suitability of the science learning material for 5-6-year-olds with the e-book media is very good/very appropriate for use. Meanwhile, the overall criteria of student response results can be seen in Table 6.

Table 6. Student Response Questionnaire Results

No	Assessment Aspects	Deskription	Precentage (%)	Criteria	
				appropriate	highly appropriate
1	Student Understanding	- Students understand the provided learning material	86		√
		- Facilitates parents in introducing the e-book to their children	92		√
		- Illustrative teaching media is easily understood	89		√
		- The presented learning material is in line with daily life	91		√
		- Scientific	93		√
		- Can be practiced directly	94		√
		- Capable of developing several aspects of child development	89		√
2	Attraction	- Engaging images	91		√
		- The story captures the child's focused concentration	87		√
		- Colors can capture the students' interest	89		√
		- Enhances students' learning interest	93		√
		- Serves as an attraction to try out directly	92		√

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In **Table 6**, the student response results can be categorized into 2 criteria. The first one is student understanding related to the effectiveness of the e-book in enhancing scientific knowledge for children aged 5 to 6 years, with an average score of 90,6%. The second one is the appeal with an average score of 90.4%. The overall average of student responses is 90.5%, as shown in **Table 7**.

Table 7. Percentage of Student Responses

Criteria	Precentage	Category
- Student Understanding	90,6	highly suitable
- Attraction	90,4	highly suitable
Average	**90,5**	**highly suitable**

Based on **Table 7**, as observed from the Likert scale, it is evident that overall, the student responses to the developed e-book have met the criteria and fall under the category of highly suitable for use in science education, with a rate of 90.5% for further advancing science education for 5-6-year-old students.

Discussion

Based on the research data results using the ADDIE model, it is shown that the development of e-book learning media to introduce science to young children, which has been tested at the TK Lab.School IKIP PGRI Jember, is highly suitable for implementation in early childhood science education. This aligns with what Ningrum and her colleagues expressed in their research on the development of the ADDIE model e-book media, which was conducted with the aim of providing a solution for introducing science in the children's surrounding environment (Ningrum et al., 2022).

One of the scientific approaches to science education is the scientific approach. Yunita, in her research, mentioned that there is an increase in critical thinking when children want to observe concrete objects during the learning process. Children become curious and start asking questions and expressing their opinions about the objects they see (Izzuddin, 2019) (Yunita et al., 2019). One of the benefits of early childhood science education is that it can increase children's interest in learning about materials/objects in their environment and natural phenomena. Science can introduce children to their surroundings, such as solid, liquid, and gas objects. Children will also learn about events they experience, such as day and night, the occurrence of rain, or rainbows (Pendidikan et al., 2020) (Iftitah & Anawaty, 2023).

Given the importance of science education for children, the introduction to science should ideally begin at an early age through various engaging methods that incorporate the concept of play (Rahmi, 2019). The use of media is crucial in the process of play-based learning for children. Not only does it facilitate teachers in delivering information, but it also makes it easier for children to receive and understand that information (Adnyani, 2021). Therefore, the availability of media in schools should also be taken into consideration to ensure the smoothness and effectiveness of the learning process (Indrawati et al., 2021). Learning media for young children are essential tools that should be owned and used during the learning process for children. In the field of education, media serves as a tool to convey information related to learning, with students as the recipients of that information. This can significantly impact the effectiveness of children's learning (Ulfadilah et al., 2021).

Research on the development of e-book media has been conducted extensively (Ningrum et al., 2022) (Susilawati, 2022) (Novitasari et al., 2019) (Wulandari et al., 2019) (Kusumatuty et al., 2018) (Sanuaka et al., 2017), The results of research on the development of e-book learning media consistently show that this learning media is suitable and effective for use in education, and it can enhance the learning outcomes of students.

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Concept analysis, in the phase of analyzing the content concept formation of this e-book, the researcher analyzed the material limitations drawn from early childhood learning, particularly in the realm of science knowledge for kindergarten children (Arifin et al., 2018).

Overall, this research contributes to providing an innovative solution for introducing science to early childhood children in a more effective and engaging manner. This can help build a strong foundation for science education and enhance children's potential for better growth and understanding in the future. The introduction of science enhances the learning experience of the students by incorporating scientific understanding of cause and effect in their environment, as well as engaging in hands-on experiments like color mixing (Sanuaka et al., 2017). This science learning is packaged in the form of an electronic book (e-book) with interspersed instructional videos. The discussion of the research results in the analysis phase, which has been conducted, is already in accordance with the previous research source. This includes an analysis of the expected basic competencies to emerge from students, an analysis of the students' initial abilities, an analysis of the indicators used to achieve basic competencies, and an analysis of the materials in accordance with the demands of the indicators and basic competencies (Naila Muna & Wardhana, 2022). The activities and stages involved in the development of e-book learning media for young children have gone through the validation phase, and through testing, they have achieved an average percentage result of 90.5%. This qualifies the e-book as highly suitable and effective for use in early childhood education.

Conclusion

This developmental research has produced a product for elementary school students in the subject of science, in the form of an E-Book with the subtheme Rain. The development of the E-Book Science-Based Learning Media using the ADDIE Model in Kindergarten is concluded to be engaging, practical, effective, and valid for use as a learning support tool. Its engaging nature is evident from the results of testing and the responses of the students at TK Lab.School IKIP PGRI Jember. Its practicality is demonstrated through field testing, where students were able to use the developed e-book media effectively. The effectiveness is supported by the results of student testing, with a percentage of 90.5% out of 100%. Its validity is affirmed by media experts, design experts, and subject matter experts, who found the media, design, and content to be engaging and capable of enhancing students' learning outcomes.

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