



Steam-Based Picture Story E-books Improve Children's Science Skills in Kindergarten

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ABSTRAK

Rendahnya kemampuan sains anak usia dini disebabkan karena kurangnya penggunaan media yang sesuai dengan tahap perkembangan anak. Adapun tujuan dari penelitian ini yakni untuk mengembangkan sebuah media pembelajaran berbentuk e-book cerita bergambar untuk diuji validitas dan efektivitasnya meningkatkan kemampuan sains anak di taman kanak-kanak. Penelitian ini termasuk kedalam jenis penelitian pengembangan dengan menerapkan model Borg and Gall. Subjek penelitian ini terdiri dari 3 ahli dalam validasi dan 38 anak untuk kelas uji coba produk. Metode pengumpulan data yang digunakan adalah kuesioner dengan instrumen penelitian berupa lembar observasi kemampuan sains anak, instrumen ahli materi, bahasa dan media. Data hasil uji validasi materi memperoleh persentase sebesar 80% kategori Valid, validasi Bahasa 100% kategori Sangat Valid, validasi media 97,33% kategori sangat valid. Uji coba kelompok kecil sebesar 78,65 % dengan dan uji coba kelas sedang 85,73 dengan kategori sangat efektif. Jadi dapat dinyatakan bahwa pengembangan e-book cerita bergambar berbasis STEAM layak dan efektif digunakan untuk meningkatkan kemampuan sains anak di Taman Kanak-kanak. Implikasi dalam penelitian ini dapat menambah variasi media digitalisasi dibidang pendidikan anak usia dini yang dapat memotivasi serta menarik minat belajar anak.

ABSTRACT

The low ability of early childhood science is due to the need for more use of appropriate media for the child's developmental stage. This study aims to develop a learning media as an e-book with illustrated stories to test its validity and effectiveness in improving children's science skills in Kindergarten. This research is included in the type of development research by applying the Borg and Gall model. The subjects of this study consisted of 3 experts in validation and 38 children for the product trial class. The data collection method used was a questionnaire with research instruments in the form of observation sheets of children's science abilities, material expert instruments, language, and media. Data from the material validation test results obtained a percentage of 80% Valid category, Language validation 100% Very Valid category, and media validation 97.33% very valid category. The small group trials were 78.65%, and the moderate class trials were 85.73 in the very effective category. So the development of STEAM-based picture story e-books is feasible and effective for improving children's science skills in Kindergarten. The implications of this research can add to the variety of digitalization media in early childhood education, which can motivate and attract children's learning interests.

1. INTRODUCTION

Early Childhood Education is one level carried out before children enter the basic education level. Early Childhood Education is carried out as a coaching effort aimed at children from birth up to the age of six through the provision of educational stimuli to help physical and spiritual growth and development so that children are ready to enter further education (Gul, 2023; Maulana & Nurhafizah, 2019; Rocmah, 2012; Susanti & Henny, 2020). The educational level of Early Childhood Education is carried out to develop various aspects of child growth and development, from the religious and moral, cognitive, physical-motor, language, social-emotional and artistic aspects (Budyawati, 2020; Hasanah & Laily, 2020). One aspect of development that should be addressed is cognitive development. It is because aspects of cognitive

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development have a very important role in children's success in learning. After all, cognitive is related to remembering and thinking (Firdaus & Rahayu, 2019; Nurqolbi et al., 2019; Supartini et al., 2020). The most important thing about the theory of cognitive development is how children can remember and apply what they have learned and use the concepts and principles they have learned (Uzlah & Suryana, 2022). Therefore the real value of aspects of cognitive development must lead to content and process. Children's cognitive development is directed at several developments, one of which is science (Indarwanti, 2018; Winangun, 2020).

Science learning is an important part of a child's life because every day, children play and interact with their environment because science is a very important part and forms the basis of early childhood education programs (Husin & Yaswinda, 2021; Qonita et al., 2022). Awareness of the importance of providing science to children is increasing because we live in a dynamic, developing and changing continuously towards adulthood, so it is increasingly complex. Science for young children differs from science for adults (Adnyani, 2021; Prasetyo, 2017). Science for early childhood is amazing, something that is found and interesting for children and provides knowledge or stimulates them to know and investigate it. Science concepts for children must be concrete and observable. Concepts that are abstract and do not exist in the realm of children are not appropriate for children; therefore, science for early childhood education is to encourage children to explore their environment and convey their observations and findings (Agustin et al., 2020; Fardiah et al., 2019; Sari et al., 2018). Early childhood science abilities consist of three components: products, namely facts, concepts, and theories; processes, namely methods and steps to acquire science; and attitudes, namely a scientific or scientific spirit (Hayati et al., 2017; Nursari et al., 2021).

It's just that the reality on the ground shows that early childhood science abilities are still relatively low. It is in line with the results of observations made at the Kindergarten in Batupanjang, Rupert, which shows several problems related to children's scientific abilities. The results of preliminary observations show that the scientific abilities of children aged 5-6 still need to be developed. Some visible problems are low curiosity, attention, and active involvement of children. Children have not been able to identify the characteristics of an object, children have not been able to identify the differences and similarities between objects, and children have not been able to classify objects based on shape, color, or size. The lack of development of children's science abilities is because learning is still monotonous. It can be seen when the teacher teaches science using the assignment method and does not use learning media that can attract children's interest. In addition, the observation results also show that teachers are still fixated on developing children's abilities to read, write and count, which are considered more important for preparing children to enter elementary school. If left continuously, this will certainly impact the growth and development of children's cognitive abilities that are not optimal.

One of the efforts that can be made to overcome this problem is by using media such as e-book media. Picture story e-books are a form of digital media that can be used as a tool to stimulate children's curiosity and interest in the learning process (Lyla et al., 2022; Zaini & Dewi, 2017). It is by the function of the media as a tool used as an intermediary in stimulating all aspects of early childhood development, which must be adapted to the age and stages of child development and carried out through play (Pahendra, 2021; Puspita et al., 2021). Picture story e-books are digitized picture story books that can be seen, read, and listened to through digital devices such as smartphones and computers (Divayana et al., 2018; Nurjamilah, 2022). Picture story e-books can properly stimulate all aspects of child development, especially cognitive development (Simamora et al., 2022; Susilawati & Rusdinal, 2022). The application of e-books in early childhood science learning will be more effective if accompanied by the STEAM learning approach. STEAM is a learning approach that invites children to formulate and solve problems displayed in a storyline (Azis et al., 2022; Ursa, 2018). Learning using the STEAM approach focuses on the process of developing 21st-century skills and children's higher-order thinking skills (Areljung & Günther-Hanssen, 2022; DeJarnette, 2018; Mu'minah & Suryaningsih, 2020).

Several previous studies have revealed that project-based learning (PjBL)-based e-books to train creative thinking skills on plant growth and development material are theoretically and empirically valid and practical for the learning process (Rahayu & Wahyuni, 2021). Other studies revealed that fourth-grade integrated thematic learning-based e-books were valid, practical, and effective for fourth-grade elementary schools (Susilawati & Rusdinal, 2022). Further research revealed that the STEAM learning method had increased critical thinking skills in the Taman Belia Asy-Syifa Study Group for ages 5-6 years (Annisa et al., 2023). Based on the results of this study, e-book media and the STEAM learning approach can significantly improve the quality of learning. In previous studies, no studies specifically discussed the development of STEAM-based picture story e-book media in improving children's science abilities in Kindergarten. So this research is focused on this study to develop a learning media in the form of a picture story e-book to be tested for its validity and effectiveness in improving children's science skills in kindergarten.

2. METHOD

This research belongs to the type of development research which is carried out using the Borg & Gall & Gall development model, which consists of the stages of identifying instructional objectives, instructional analysis, identifying learning and context, formulating learning objectives, developing instruments, preparing instructional strategies, developing and selecting learning materials, as well as designing and conducting formative evaluations. The subjects involved in this study were 38 children at Pembina Rupert Kindergarten. Data collection in the study was carried out by using a questionnaire that was used when validating by material experts, media experts, and linguists, as well as observation sheets to see the effectiveness of the media in improving children's science abilities. The research instrument grid can be seen in [Table 1](#).

Table 1. Research Instruments

Aspect	Indicator	Item Number	Total Item
Quality of content and purpose	1. Compatibility of Core Competencies and Basic Competencies with the Early Childhood Education Curriculum	1	7
	2. Specific and clear learning objectives	2	
	3. Suitability of the material with Core Competencies and Basic Competencies	3	
	4. The material presented is by the child's scientific abilities	4	
	5. Clarity of the contents of the story conveyed	5	
	6. The suitability of story content with early childhood cognitive development	6	
	7. Improve children's scientific abilities	7	
Instructional quality	1. Helping children and teachers in the learning process	8	5
	2. Has an attractiveness value in the learning process	9	
	3. Able to develop children's scientific abilities	10	
	4. Media can be used easily	11	
	5. Clarity and readability of the language used	12	
Total			12

The data obtained in the study were then analyzed using descriptive statistical analysis techniques, namely by describing the validity level of media material and language to obtain quality products that meet validity. Validity test scores using a Likert scale are very good (5), good (4), good enough (3), not good (2), and bad (1). Children's ability scores are measured by a scale of Very Well Developed (4), Developing According to Expectations (3), Starting to Develop (2), and Not Yet Developed (1). Data from the test results of developing a picture story e-book were analyzed using a percentage formula. Further, the results of the data analysis obtained can then be interpreted in [Tables 2 and 3](#).

Table 2. Interpretation of Validity Test Results Based on Percentage

Eligibility Percentage	Eligibility Criteria Validity	Description
$P \leq 20$	Invalid	Revision
$P > 20; P \leq 40$	Invalid	Minor revision
$P > 40; P \leq 60$	Valid Enough	Minor revision
$P > 60; P \leq 80$	Valid	No revisions
$P \leq 80$	Very Valid	No revisions

Table 3. Interpretation of the Effectiveness Test Results of Picture Story E-books Based on Percentage

Criteria	Effectiveness Level	Percentage (%)
Undeveloped	Ineffective	1-25
Start developing	Less effective	26-50
Developed as expected	Effective	51-75
Very well developed	Very effective	76-100

Data analysis on the effectiveness of scientific abilities was followed by testing the N-gain test and paired sample t-test using SPSS. The test results can be interpreted based on [Table 4](#).

Table 4. Interpretation of the Effectiveness Test Results of the Picture Story E-book Based on Percentage

Score range	Criteria
$Ngain > 0.7$	High
$Ngain \leq 0.3; Ngain \leq 0.7$	Medium
$Ngain \leq 0; Ngain \leq 0.3$	Low
$Ngain < 0$	Failed

3. RESULTS AND DISCUSSION

Result

This research produced a learning media in the form of a STEAM-based picture story E-book which has been tested for validity so that it is suitable for use to improve children's science skills in kindergarten. This media was developed using the Borg and Gall model, with the results of each stage described as follows: The first stage is the identification of instructional objectives, which is carried out by observing the Kindergarten Pembina Rupert with observation data on children's scientific abilities of 45.30% in the category Start Growing. The interviews with school principals and teachers revealed that school science learning rarely occurs due to needing more learning media. If implemented, the media is only in the form of providing children's worksheets. The results of the interviews also showed that the use of picture story e-books had never been used in kindergarten on any theme. The second stage is instructional analysis. At this stage, an analysis identifies the skills, attitudes, and knowledge that children must develop to achieve learning objectives. Researchers in developing products aim to describe the development of STEAM-based picture story e-books that can improve children's scientific abilities. The results of identifying indicators of scientific ability are divided into 3, namely knowledge, processes, and attitudes.

The third stage is learning and context identification. At this stage, the researcher analyzes the characteristics of children in developing products based on observations at Pembina Rupert Kindergarten, the research location. Based on the initial observations of children aged 5-6 years, the following results were obtained: first, some children have started to be able to read the writing that is drawn. However, the child is still shy and afraid of being wrong in answering the questions given. Second, when the teacher asks, children want to take turns playing with toys. Third, children are enthusiastic when carrying out learning using interesting media. Fourth, interesting media provoke children's curiosity. Fifth, initial observations of early childhood science abilities show that children's scientific abilities are at a low percentage and need to be stimulated to develop as expected. At the same time, identifying the learning context is related to determining the material's content to be developed according to the basic competencies and core competencies of children aged 5-6 years in kindergarten. The fourth stage is formulating learning objectives. At this stage, indicators of scientific ability for children aged 5-6 years are made based on theories of cognitive development. The formulation of performance goals can be seen in [Table 5](#).

Table 5. Learning objectives

No	Learning objectives
1	Children can know the contents of the story in the e-book.
2	Children know the concept of plants.
3	Children can identify pictures in e-books.
4	Children can use the appropriate senses (see and hear)
5	Children can see the similarities in the pictures in the pictures.
6	Children can see the difference in e-books.
7	Children can group pictures in e-books by color.
8	children can group pictures by size
9	Children can group pictures in e-books by type.
10	Children can measure pictures in e-books.
11	Children can explain pictures in their language.
12	Children ask about stories that have been read enthusiastically.
13	Children can answer the questions given

The fifth stage is the development of the instrument. The instrument was developed through a lattice of financial instruments based on early childhood scientific abilities theory. Assessment of children's learning outcomes is done through authentic assessments with instruments like observation sheets. The lattice of the Science Ability Instrument for Children Aged 5-6 can be seen in [Table 6](#).

Table 6. Science Ability Instruments for Children Aged 5-6 Years

Indicator	Assessment Aspects	Item Number
Knowledge	Children can know the contents of the story in the e-book	1
	Children know the concept of plants	2
Process	Children can identify pictures in e-books	3
	Children can use the appropriate senses (see and hear)	4
	Children can see the similarities in the pictures in the pictures	5
	Children can see the difference in e-books	6
	Children can group pictures in e-books by color	7
	Children can group pictures by size	8
	Children can group pictures in e-books by type	9
	Children can measure pictures in e-books	10
	Children can explain pictures in their language	11
Attitude	Children ask about stories that have been read enthusiastically	12
	Children can answer the questions given	13

The sixth stage is the preparation of instructional strategies based on the learning objectives to be achieved or to help learning achieve specific goals. The learning strategy is designed according to the product or design to be developed, namely STEAM-based picture story e-books to improve children's science skills in kindergarten. The process of compiling competencies, formulating concepts, and the time allocation described in the form of Daily Learning Implementation Plans (RPPH) is being developed at this stage. The seventh stage is the Development and selection of Learning Materials. The product is developed based on a certain type, type, and model. This picture story e-book uses the STEAM-based learning concept adapted to early childhood science abilities. The product design stage of the STEAM-based picture story E-book is to design a storyline that is by the product the researcher wants to develop.

The eighth stage is designing and formative evaluation. At this stage, the design development is carried out to become a product, and a formative evaluation is carried out. The following are the stages in designing a STEAM-based picture story E-book. The design process uses the Procreate application drawn via an Ipad. The type of font used is chalkboard. The development of this picture story e-book measures 25x25 cm. After designing the image, the researcher began to color the design and provide shading to compile a picture story e-book into a ready-to-use product. The following shows a science-based picture story e-book to improve children's science skills in Kindergarten. Products that have been developed are then tested for validity. The results of the validity test can be seen in Table 7.

Table 7. Percentage of Validation and Trial Results of Picture Story E-book Products

No	Subject	Validity Test Results (%)	Description
1	Validasi Materi	80,00	Valid
2	Validasi Bahasa	100	Sangat Valid
3	Validasi Media	97,33	Sangat Valid

After experts have validated the product, it is continued with trials on research subjects, namely children aged 5-6 years in Pembina Rupert Kindergarten. The results of trials in small and medium classes can be seen in Table 8.

Table 8. Test Results in Small and Medium Classes

No	Subject	Pretest Score	Description	Posttest Score	Description
1	Small class trials	42,31	MB	78,65	BSB
2	Medium class trials	41,95	MB	85,73	BSB

Discussion

Research on the development of STEAM-based picture story e-books shows that the media developed is in a very valid and appropriate category to be used as a medium to improve children's scientific abilities in kindergarten. Several factors influenced the success of this product development, namely, an illustrated story e-book developed according to the field's needs to solve the problem of children's scientific abilities that had yet to develop optimally. The research results support that using e-books or digital storybooks can improve children's science skills (Lyly et al., 2022). The developed media has an attractive

design for children so that children's interest in learning and curiosity is optimally stimulated to pay attention to and carry out the learning process (Maghfiroh & Suryana, 2021). Furthermore, several main findings were obtained in the study based on product development and expert validation results. The first finding relates to the validation results by material experts, which showed that the material contained in the picture story e-book obtained a percentage of 80% with a valid category. These results indicate that the illustrated story e-book developed is valid and suitable for use by children in the learning process, especially in children's science abilities, where this technology-based learning media facilitates the learning process in terms of effectiveness and efficiency (Syamsuar & Reflianto, 2019; Widiyanto, 2021).

The second finding relates to language validation carried out by linguists. The developed illustrated story e-book obtained a percentage of 100% in the very valid category. The aspects assessed from language validation are language and readability. The indicators assessed from the linguistic aspect are language in easy-to-understand media for children aged 5-6 years, clarity of language from instructions for use, using communicative language, and a simple writing style. Whereas in the readability aspect, the indicators assessed are the accuracy of the text with the story, the accuracy of spelling, the letters used are simple and easy to read, the suitability of using Indonesian, the layout of the text is appropriate and the accuracy of the type of font size in the picture story e-book. The results of the linguist's assessment show that the illustrated story e-book can be used without revision because it is suitable for children aged 5-6 years (Halim & Munthe, 2019; Lubis & Dasopang, 2020). Using appropriate language in media will make it easier for children to understand the contents of the media presented, where the language must be adapted to aspects of the child's language development (Annisa et al., 2023).

The third finding relates to media validation carried out by media experts. The developed illustrated story e-book obtained a percentage of 97.33% in the very valid category. This STEAM-based picture story e-book was developed based on an analysis of the existing needs for alternative media as a digital learning resource according to the times that can appeal to children to improve children's scientific abilities. Judging from the graphical aspect, this picture story e-book has an attractive design for children and effectively clarifies the material to increase children's learning motivation (Trisiana, 2020). Furthermore, from the aspect of the presentation, the choices of images displayed are very diverse and concrete so that they can stimulate children's attention and increase children's scientific abilities. It is in line with the theory that states that the learning media used aims to channel messages from senders and recipients of messages so that they can stimulate children's thoughts, concerns, feelings, and interests (Andriyani & Suniasih, 2021; Indahini et al., 2018).

The fourth finding relates to the results of a small class trial involving ten children at Pembina Rupert Kindergarten. The pretest results obtained an average percentage of 42.31 in the Starting to Develop category. In contrast, after learning using picture story e-books, the posttest results obtained a percentage of 78.65 in the Very Well Developed category. It shows increased children's scientific abilities before and after using picture story e-books in learning. These results also show that the picture story e-book media presentation can help increase children's interest in science and motivate them to learn more. In addition, e-books with picture stories can also facilitate active learning, where children can learn science more interactively and interestingly, for example, by carrying out simple experiments or answering questions in the book (Ayuningtyas & Wijayaningsih, 2020; Karlina et al., 2018; Novitasari & Prastyo, 2020).

The fifth finding relates to the results of the medium-grade trial involving 38 children at Pembina Rupert State Kindergarten. The pretest results obtained an average percentage of 41.95 in the Starting to Develop category. At the same time, the posttest results after learning using the illustrated story e-book obtained a percentage of 85.73 in the Very Well Developed category. The results of this middle-class trial showed an increase in children's science abilities before and after using the picture story e-book. Furthermore, the results of class trials indicate that the illustrated story e-book developed is very suitable for learning activities, especially to improve science skills. Using picture story e-books helps children understand science concepts visually through interesting pictures and animations. Picture story e-books can help children understand science concepts in a way that is clearer and easier to understand, increases children's imagination, picture story e-books can help enhance children's imagination and help them visualize complex science concepts (Divayana et al., 2018; Nurjamilah, 2022; Simamora et al., 2022; Susilawati & Rusdinal, 2022).

The results obtained in this study are in line with the results of previous research, which also revealed that project-based learning (PjBL) e-books to train creative thinking skills on Plant Growth and Development material were stated to be theoretically and empirically valid and practical for use in the learning process (Rahayu & Wahyuni, 2021). Other studies revealed that fourth-grade integrated thematic learning-based e-books were valid, practical, and effective for fourth-grade elementary school use (Susilawati & Rusdinal, 2022). Further research revealed that the STEAM learning method had increased critical thinking skills in the Taman Belia Asy-Syifa Study Group for ages 5-6 years (Annisa et al., 2023).

Based on the results of this study, e-book media and the STEAM learning approach can significantly improve the quality of learning.

4. CONCLUSION

Based on the data analysis and discussion results, it can be concluded that STEAM-based picture story e-book media is valid and appropriate for use in the learning process because it can improve children's scientific abilities in kindergarten

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