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Development of Digital Media for Sundanese Culture-Based Dakon Games to Improve Early Childhood Science Literacy

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Abstract: This study aims to develop the Dakon game into a digital Android-based game, Smartda (Smart Dakon), to enhance science literacy in early childhood. The research employs the Research and Development (R&D) method with the Borg & Gall model combined with the ADDIE model for game media development. The subjects involved 111 children and 7 teachers. The research instruments included questionnaires, interviews, and structured observations. Furthermore, the data were analyzed using qualitative and quantitative descriptive. The results show that: (1) The game media development process was reconstructed into a conceptual model, procedural model, and physical model in the form of a Smartda digital application and a Smartda game guidebook. (2) The Smartda game is feasible for improving early childhood science literacy, validated by expert tests with minor revisions and declared highly feasible by three validators. (3) The Smartda game model is quite effective in enhancing science literacy in early childhood, potentially impacting the development of all aspects of early childhood development.

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Introduction

Rapid changes in the world due to advances in technology and science, scientific literacy is needed to understand and deal with these changes (OECD, 2018). According to Widayati et al., (2020) early childhood scientific literacy focuses on children's ability to use scientific thinking to respond to various scientific questions and problems. Instilling Scientific Literacy as early as possible will enable children to overcome everyday problems and form the basis for children to be more competent in science (OECD, 2018) and when children grow into individuals with high competence which can ultimately increase the economic growth of a country (Hanushek & Wößmann, 2015). The acquisition of scientific literacy knowledge begins in early childhood and increases in line with cognitive development and language development in their environment (Gelman & Brenneman, 2004). The results of research in Europe and the United States consistently show that there are two important learning environments for the development of early childhood science literacy, namely the parental home and kindergarten (Melhuish et al., 2008; NICHD, 2002, 2003; Sylva et al., 2010; Tietze et al., 1998).

When compared to other countries in the world, the literacy rate of children and adults in Indonesia is very low, based on the results of a survey by Central Connecticut State University or CCSU (2016) in the World's Most Literate Nations Ranked in its publication on March 9, 2016 on the ranking of Literacy behavior in 61 countries, it was revealed that Nordic countries (Finland, Iceland, Denmark, Sweden, and Norway) occupy the highest

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ranking. While Indonesia is ranked 60th, low literacy is a fundamental problem that has a very broad impact on the progress of the nation.

Science literacy in Indonesia began to be accommodated in the 2006 curriculum (KTSP) and was more clearly seen in the 2013 curriculum through inquiry activities and scientific approaches (Astuti, 2016). Implementing science literacy should be started as early as possible (Bybee, 2008) because science literacy is closely related to the lives of early childhood as a whole, including the child himself, such as children recognizing their body parts, recognizing their surroundings, and so on. Science literacy has great potential to be fostered and developed in early childhood and is important for students to have in understanding the environment and caring for their surroundings so that children can protect the environment and even solve problems in their environment. Science literacy can also shape mindsets, recognize, realize, behavior, and build children's character to care and be responsible for themselves, the universe, and problems faced in an environment that is highly dependent on technology so that it can encourage children to communicate, think critically, creatively and collaborate.

Indonesia is a country that is very rich in cultural diversity, has many regional languages, customs, traditional foods, traditional clothes, traditional fabrics and traditional games. Previous research is the basis that the traditional dakon game has a positive impact on learning activities in early childhood such as According to Harbiyah (2022) and Roostin, (2018) the traditional congklak game (Dakon) can develop aspects of early childhood development, children can show honest behavior, a sporty spirit, an attitude of obedience to rules, while according to Wahyuni, (2020), the traditional congklak game has a positive influence on children, because this traditional game teaches children to set the right strategy so that they do not make mistakes in taking steps and children can play while learning. According to Simajuntak and Miswara (2018), the traditional congklak game has a significant effect on the early arithmetic skills of early childhood children and according to Lacksana, (2017) Local Wisdom Congklak game as strengthening the character of students through guidance and counseling services in schools

According to Hapidin and Yenina (2016) the tradition of society that creates happy and enjoyable situations and activities is a form of expression and appreciation of traditional games. Traditional games, especially dakon, are important for early childhood, because they are part of the early generation of Indonesian children, especially Sundanese children. Being a regional child certainly does not forget their own culture. In addition, the dakon game also has many benefits for children such as training fine motor skills, honing counting skills, learning to be patient, learning to be honest, learning to understand the rules and children still know and preserve traditional games. In general, the appearance and form of the dakon game still uses the previous game, so that the lack of interest in the dakon game, both in terms of design, how to play, and function, makes this game less competitive with technology-based games. Efforts to meet these needs require the development of a traditional dakon game that can attract children's interest and stimulate aspects of their development by integrating the traditional dakon game into a modern game using digital media that is more interesting to children (Roostin, 2022).

Various previous studies serve as references and reflections in innovating in developing traditional games based on Sundanese culture into interesting games that can improve Science Literacy for early childhood. Studies with the variable of the dakon game (congklak) that have been conducted by several researchers such as the results of research by Mulyani et al., (2020) and Hestyaningsih, L., & Dinar Pratisti, W. (2021) show that an increase in numeracy skills through the traditional Dakon game is also effective for the

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numeracy skills of early childhood. In line with the research of Saugi, W. (2020) the traditional dakon game can improve numeracy skills in mentally retarded children. Research by Harbiyah (2022) and Roostin (2022) shows that the traditional dakon game can develop 6 aspects of Early Childhood development. However, from several previous studies, no research has been found regarding the development of the traditional dakon game using Sundanese culture-based android digital media which is focused on helping to improve Science Literacy in children aged 5-6 years.

Based on the results of pre-research in several PAUD institutions in West Java Province, it was revealed that there are problems that cause low children's abilities in Science Literacy, including; (1) lack of teacher experience in helping children develop science literacy and lack of media related to science literacy practices. (2) learning media delivered by teachers are less interesting, causing children to be less interested so that children's awareness of science literacy in their environment and children's cognitive abilities are limited (3) children are less familiar with traditional games based on Sundanese culture, and do not even know how to play them. Therefore, solutions are needed, such as (1) increasing teacher knowledge to help children develop science literacy related to science literacy practices. (2) Science literacy skills in children are stimulated with educational game tools. 3) Development of the traditional dakon game into a Smartda (Smart Dakon) game which is more interesting and modern and integrated with science literacy based on Sundanese culture.

The development of digital media based on Sundanese culture is seen as important as an implementation of the national education function of the Republic of Indonesia and as a successor to culture in West Java. In line with the research results of Naughton et.al (in Gandana, 2022) which states that the use of digital media in developing children's potential is very permissible on condition that there is special development and design in advance on the digital media to be used.

The purpose of this study was to describe the results of the needs analysis related to the ability to master scientific literacy in early childhood, the process of developing the traditional dakon game into Smartda, describing the level of quality of the feasibility of developing the Smartda game and the results of the effectiveness test of developing the Smartda game based on Sundanese culture to improve Scientific Literacy in early childhood (5-6 years) in Kindergarten B, West Java Province.

Research Method

The method used in this research is research and development with the Borg and Gall model combined with the ADDIE model in the development of digital android-based game media. The Smartda game development procedure consists of: (1)*research and information colleting*, (2) planning, (3) develop preliminary form of product, (4) preliminary field testing, (5) main product revision, (6) main field testing, (7) operational product revision, (8) operational field testing, (9) final product revision, and (10) dissemination and implementation (Borg and Gall 2003). Furthermore, in this study, the Borg and Gall research and development model is combined with the ADDIE model at the game media development stage consisting of 5 phases or main stages, namely (1) analyze, (2) design, (3) develop, (4) implement, and (5) evaluate.

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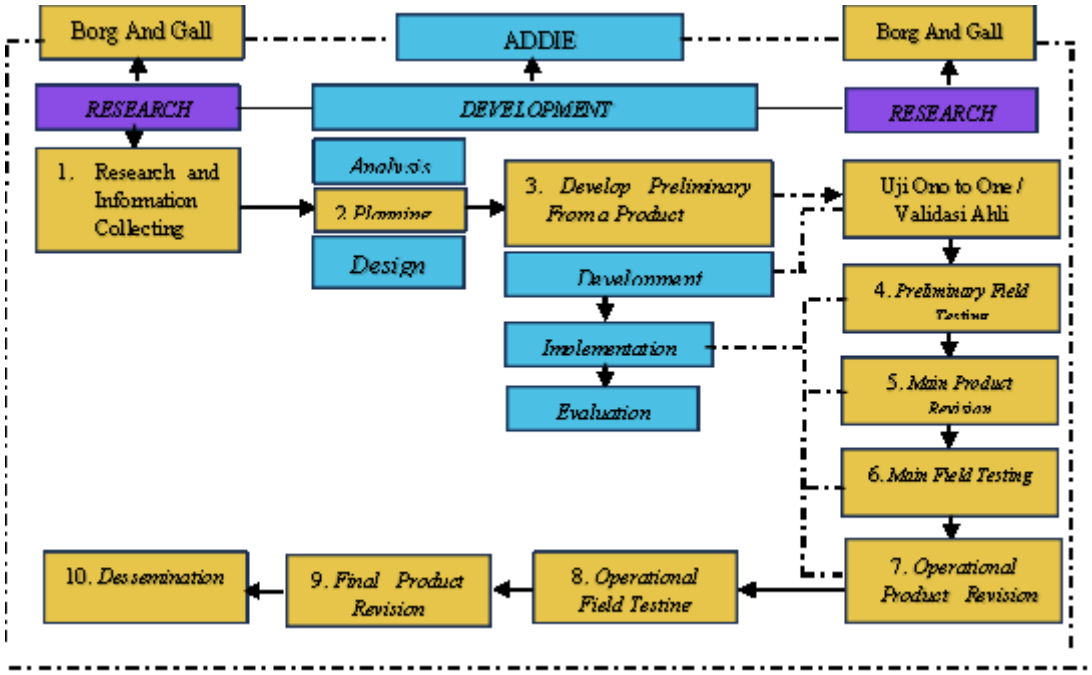

Figure 1. Combination research procedure of Borg and Gall (1983) with EDDIE (Branch, 2009)

The data collection technique for this research used: (1) semi-structured interviews to collect data on responses from teachers and kindergarten principals in Sumedang, Majalengka, Subang and Garut districts regarding the need for development and after the implementation of Smartda game media based on Sundanese culture, (2) process assessment observations in the form of scoring rubrics (checklists) to measure the increase in science literacy in children aged 5-6 years, (3) field notes (anecdotal notes) to support data from observation activities, and (4) documentation to support data from the research implementation process.

This study uses qualitative and quantitative data analysis techniques. Qualitative data analysis is used to process data from expert reviews of media, PAUD materials and PAUD practitioners and group B teachers in Sumedang, Subang, Garut and Majalengka Regencies. Quantitative analysis is used to explain the feasibility of the Smartda android digital media. Quantitative data is obtained using a Likert scale. Product effectiveness is measured using the N-Gain Score, Small and large group tests using paired sample T-tests based on pre-post tests and Effectiveness tests are carried out using independent sample T-tests based on pre-post tests.

Results and Discussion

1) Research and Information Collection Stage

The initial step in media development is to conduct initial research and collect information using various techniques, such as observation, interviews, and also surveys using prepared questionnaires.

2) Development Planning Stage (Planning)

Planningmedia development is carried out as a follow-up to the preliminary stage of the needs survey. At this stage, researchers design Flowcharts and Story Boards or application content scripts that are discussed directly with media experts.

3) Initial product media development stage

Based on the data obtained through literature study and needs analysis through preliminary research, the next step is to compile an initial draft of the development of Android digital media. This product development stage adopts the Borgh and Gall development steps combined with the ADDIE model which produces a conceptual model, procedural model and physical model.

4) Limited trial

A small-scale trial was conducted at PWS Kindergarten in Sumedang Regency with an N-Gain Score of 0.66 with moderate criteria. Smartda android digital media is used to support efforts to improve science literacy in children aged 5-6 years.

Table 1. Limited Trial

No	Nama Lembaga	Jumlah Sampel	Katerangan	Hasil *N-Gain Score*	Kriteria
1.	TK PWS (Kabupaten Sumedang)	18	Terdapat perbedaan kemampuan literasi sains sebelum dengan setelah menggunakan Media permainan berbantuan aplikasi Smartda	0,66	sedang

Based on the recapitulation results before and after the implementation of Smartda media, researchers can see the profile of increasing Science Literacy.

Table 2. Statistical data of observations of science literacy in PWS Kindergarten before implementation Smartda digital android media

N	Mean	Median	Mode	Min	Max	Sum
16	18.19	18	18	18	19	291

Table 3. Statistical data on observations of science literacy in PWS Kindergarten after implementation Smartda digital android media

N	Mean	Median	Mode	Min	Max	Sum
16	32.6	32	34	30	37	522

5) Initial product revision

This stage is the process of revising the main product from the weaknesses found in the initial field test stage resulting from input from teachers in the classroom.

6) Large Scale Test

Based on the results of large-scale trial data analysis from four kindergartens in West Java Province, the N-Gain Score results can be averaged to 0.72, which has high criteria. Smartda Android digital media is used to support efforts to improve science literacy in children aged 5-6 years.

Table 5 Large Scale Test

No	Nama Lembaga	Jumlah Sampel	Katerangan	Hasil *N-Gain Score*	Kriteria
1.	TK DD (Kabupaten Subang)	12	Terdapat perbedaan kemampuan literasi sains sebelum dengan setelah menggunakan Media permainan berbantuan aplikasi Smartda	0,77	Tinggi
2.	TK PBI (Kabupaten Garut)	13	Terdapat perbedaan kemampuan literasi sains sebelum dengan setelah menggunakan Media permainan berbantuan aplikasi Smartda	0,67	Sedang
3.	TK MNU (Kabupaten Sumedang)	20	Terdapat perbedaan kemampuan literasi sains sebelum dengan setelah menggunakan Media permainan berbantuan aplikasi Smartda	0,64	Sedang
4.	TK HD (Kabupaten Majalengka)	14	Terdapat perbedaan kemampuan literasi sains sebelum dengan setelah menggunakan Media permainan berbantuan aplikasi Smartda	0,79	Tinggi

The large-scale trial process was carried out as well as the limited trial, the implementation time was adjusted to the teacher's learning schedule in each class. This large-scale trial was

carried out in four kindergartens in districts in West Java Province such as Majalengka, Subang, Garut and Sumedang.

Table 6. Statistical data on scientific literacy observations before implementation Media Smartda TK DD, TK PBI, TK MNU and TK HD.

No	Location	N	Mean	Median	Mode	Min	Max	Sum
1	Kindergarten DD	12	18.67	19	19	17	20	224
2	PBI Kindergarten	13	16.15	16	15	11	24	210
3	MNU Kindergarten	20	26.20	26	24	23	30	524
4	Kindergarten HD	14	18.64	18.50	18	18	20	261

Table 7. Statistical data on scientific literacy observations after implementation Media Smartda TK DD, TK PBI, TK MNU and TK HD.

No	Location	N	Mean	Median	Mode	Min	Max	Sum
1	Kindergarten DD	12	35.08	34.50	32	32	40	421
2	PBI Kindergarten	13	34.54	35.00	35	33	36	449
3	MNU Kindergarten	20	35.05	35.00	33	33	40	701
4	Kindergarten HD	14	35.43	34.50	38	30	40	469

7) Operational product revision

This is a step to improve Sundanese culture-based digital media based on media deficiencies from data from field trials, mainly the result of teacher input in class.

8) Operational field test (effectiveness of media in improving science literacy)

Operational field trials were conducted in one kindergarten school, but two different classes, namely the control class (B1) and the experimental class (B2) located in Sumedang district. Based on the results of the N-Gain Score in the control group of 23.54 which is included in the ineffective criteria. While in the experimental group the N-Gain score of 71.83 is included in the fairly effective category. So it can be said that the use of the Smarda application is quite effective in increasing the science literacy scores of early childhood

Table 8. Operational Field Test

No.	Nama Lembaga	Jumlah Sampel	Keterangan	Hasil N-Gain Score	Kriteria
1.	TK AS (Kontrol)	16	Terdapat perbedaan sebelum dan setelah pembelajaran dengan media gambar dan metode bercakap-cakap namun tidak efektif dalam meningkatkan literasi sanis.	23,54	Tidak Efektif
2.	TK AS (Eksperimen)	16	Terdapat perbedaan kemampuan literasi sains sebelum dengan setelah menggunakan Media permainan berbantuan aplikasi Smartda	71,83	Cukup Efektif

Table 9. N-Gain Score Control Class and Experimental Class

No	Kelas Kontrol N-Gain Score (%)
1	24,00
2	11,54
3	11,54
4	17,39
5	0,00
6	28,00
7	20,83
8	19,23
9	25,93
10	29,17
11	32,14
12	38,46
13	26,09
14	26,92
15	33,33
16	32,00
Rata-rata	**23,54**
Minimal	**0,00**
Maksimal	**38,46**

No	KelasEksperimen N-Gain Score (%)
1	72,73
2	77,27
3	81,82
4	78,26
5	60,00
6	72,73
7	61,90
8	77,27
9	72,73
10	72,73
11	63,64
12	72,73
13	80,95
14	68,18
15	72,73
16	63,64
Rata-rata	**71,83**
Minimal	**60,00**
Maksimal	**81,82**

Percentage (%)	Interpretation
< 40	Ineffective
40 - 55	Less Effective
56 -75	Quite Effective
> 76	Effective

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9) Final product revision

This final product revision is a stage of improvement before obtaining game media that truly meets the development objectives.

Figure 2. Smartda Application Products and Game Guidebook

10) Implementation and Dissemination

The implementation and dissemination stages in this study are the final steps of the research process. Dissemination of research products in the form of digital media android Smartda based on Sundanese Culture is carried out through international seminar activities and scientific publications in international journals.

Discussion

This research produces a Smartda android digital media application to improve science literacy in early childhood accompanied by a Smartda game guidebook. The initial media development stage is the production stage of the Smartda Application development which is carried out through collaboration with several experts in computer software engineering developers. The development of the initial design of this Smartda digital media consists of developing conceptual and physical product designs, developing the initial form of Smartda digital media, developing the initial form of the game guidebook, using Smartda digital media, and the initial form of the Smartda digital media-assisted learning procedure as well as the feasibility of Android digital media involving 3 media experts, 2 material experts and 2 PAUD practitioner experts.

Based on the process of embedding educational values that are considered important contextually and textually. During the process of developing digital media based on Sundanese Culture, the embedded values are certainly the basis for developing the Smartda application. Ultimately, the process produces a product in the form of the Smartda Application which contains educational values to encourage early childhood education in West Java Province. These values are the guarantee and responsibility of researchers on the basis of the interests of early childhood education in West Java Province.

The following is a picture of the conceptual model of the Sundanese Culture-Based Smartda Game;

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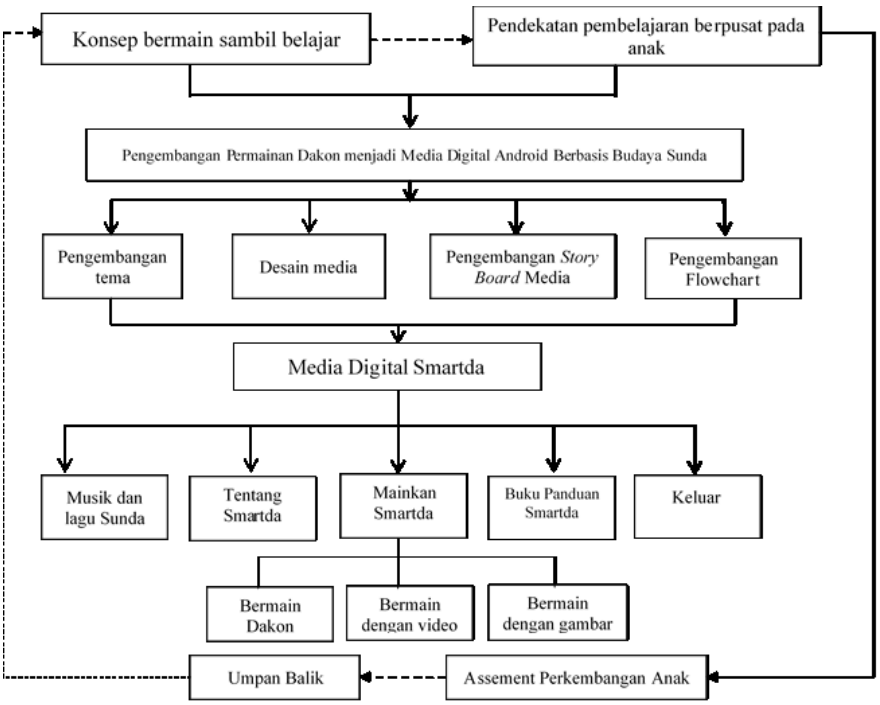

Figure 3. Conceptual Model of Smartda Based Games Sundanese culture

Smartda android digital media eligibility assessed using a questionnaire that was created and validated by experts to produce a valid and feasible questionnaire. The assessment of the feasibility of Android digital media involved 3 media experts, 2 material experts and 2 PAUD practitioner experts, each aspect of the assessment involved in this feasibility test. The following are the results of the Android Smartda digital media feasibility test, the results of the judgment of 3 media/software engineering experts, the percentage of feasibility is 95% declared feasible and 5% declared feasible with improvements, with very good qualifications. The results of the judgment of 2 PAUD material experts, the percentage of feasibility is 98% declared feasible and 2% declared feasible with improvements, with very good qualifications and the results of the judgment of 2 PAUD Practitioner experts, the percentage of feasibility is 96% declared feasible and 4% declared feasible with improvements, with very good qualifications. Thus, Smartda media is feasible to be used in early childhood to improve science literacy. This is in line with the results of Heinich's research (2002), which states that changing educational media into digital multimedia is an effective way to obtain educational facilities. Increasing science literacy for Early Childhood in West Java Province, Smartda application as a media that is worthy of being applied in Early Childhood Education in West Java Province in the era of information technology is part of modern life. According to Kashi (2018), digital has now become part of the human body. This can also include early childhood who are in the era of the industrial revolution 4.0.

The effectiveness of Smartda android digital media in improving early childhood science literacy in this limited trial involved 1 PAUD institution in Sumedang Regency, namely TK AS. The sample in this limited trial was 16 children in group B1 for the control class and 16 children in group B2 for the experimental class. Data collection at the institution used an instrument to improve science literacy, which was then seen in the analysis of differences in children's science literacy before and after the application of Smartda android digital media.. The results of the Control Class Post Test and the results of the Experimental Class Post Test were tested with the aim of seeing whether there was a difference in the

science literacy scores of students who used Smartda and those who did not use it. The results showed that the average literacy score of the control class was 20.75 and the average literacy score of the Experimental class was 33.88. This shows a difference in the average between the two treatments. The experimental posttest score was higher than the control posttest score. sig. value. (2-tailed) of 0.000 <0.05, then the decision to Reject H0 means that there is a significant difference between the science literacy scores of students who use Smartda and those who do not use it. The science literacy scores of students who use Smartda are higher than those who do not use it, meaning that the use of Smartda gives better results than the usual method.

N-Gain Score Test conducted to test the effectiveness of the influence of the Smarda android application on students' science literacy scores using the percentage or score results, the results of the N-Gain Score test using SPSS 26. Based on the N-Gain Score test criteria above and from the results of the N-Gain Score test calculation, it is known that the N-Gain Score value for the control class of 23.54 is included in the ineffective category, with a minimum N-Gain Score value of 0% and a maximum of 38.46%. While the average N-Gain Score for the experimental class is 71.83% included in the fairly effective category. With a minimum N-Gain Score value of 60.00% and a maximum of 81.82%. Thus, it can be seen based on the N-Gain Score test, the average value of the experimental group given the Smarda application intervention has a higher literacy score than the average value of the control group that was not given the intervention. Therefore, digital media in early childhood education must be part of the current strategic concept to integrate early childhood education facilities (Koentjaraningrat, 2009; Cojocariu & Boghian, 2014; Gandana, 2019; and Yasbiati et al., 2019). Another opinion according to Tilaar (2007), the instillation of cultural values in a person can be shown by a person's knowledge, understanding, and behavior in accordance with the culture they hold firmly.

Conclusion

The conclusion obtained from the results of this study is that; (1) The process of developing the Dakon game using Android digital media resulted in a conceptual model, procedural model and physical model in the form of the Smartda digital media application and the Smartda game guide book. (2) The results of the feasibility test show that the Smartda android digital media is in very good qualifications. The results of the assessment indicate that the Smartda android digital media is very feasible to be applied to learning activities or playing in improving early childhood science literacy. (3) Smartda game media is quite effective in improving science literacy in early childhood based on the results of field trial data analysis with a high NGains score. With the existence of an innovative game model, it can have an impact on increasing the ability of all aspects of early childhood development.

Recommendation

The recommendations submitted based on the results of this study are:

1) For educators (teachers and parents)
   For educators (teachers and parents) should provide special guidance to every early age child in using digital media android application Smartda to ensure the truth and limitation of gadget usage (smart phone) that is in accordance with the capacity and safety for early age children. In addition, in using the Smartda Application, teachers and parents should provide digital media facilities to strengthen children's understanding of scientific literacy. The use of Smartda media should not only be done during the theme of plants, animals and the

environment which is specifically for learning in class, but can be used every day in play activities so that children get continuous stimulation to increase scientific literacy.

2) For the principal
Principal policy recommendations to support the implementation of Smartda media
   a) Smartda integration in learning activities
      Integrating Smartda game media into RPPH (Daily Learning Implementation Plan) as part of thematic learning based on science literacy and numeracy for early childhood.
   b) Regular Teacher Training
      Organizing internal training and workshops for PAUD teachers in the use of Smartda media and game-based science-numeracy literacy strengthening strategies.
   c) Provision of Supporting Technology Facilities
      Equipping school facilities with technological devices (educational tablets/smartphones) to support the use of Smartda digital media in learning activities.
   d) Collaboration with Parents and School Committee
      Involving parents in the use of Smartda at home as part of ongoing learning.
3) For the government and early childhood education policy makers
It is expected to pay more attention to the suitability of early childhood education media facilities so that they are in accordance with the fulfillment of the child's environmental needs based on the instillation of local Sundanese cultural values and current developments (digital era).
4) For other researchers and developers of early childhood education media
In order to focus more on the values of developing children's potential so that every child's self-competence developed through digital media stimulation can be utilized in the child's life in the future. This study should also be a basis for other researchers to conduct similar research using android digital media in developing scientific literacy skills with other content.

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