Development of an Educational Model in Stimulating the Growth and Development of Children Aged 2-5 Years: Dick and Carey's Intervention Design

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ABSTRACT

Aims Early identification of a young child with developmental delays or deficits is recognized as an essential part of good healthcare for children in regular pediatric practice. This study aimed to design and develop an educational model to guide mothers of toddlers to increase their knowledge and skills about assessing growth, development, and stimulation of child development.

Materials & Methods This research is a quasi-experimental study using a two-group pretest-posttest design, which was carried out at the Aurdauri Public Health Center, Jambi City, Jambi Province, Indonesia, in May – November 2022. The subjects were 31 mothers of children aged 2–5 years old who were randomly selected with the criteria of being able to use Android properly and distributed into small groups (n=15) and large groups (n=16). The small group used the application with assistance and the large group without assistance. Data were analyzed using the paired t-test.

Findings 82% of the mothers could not distinguish between growth and development, 82% knew about growth stimulation, 91% wanted to know about growth and development stimulation, and 90% preferred audiovisual information. The development of learning materials to stimulate the growth and development of 2–5 years children led to educational applications, and the use of android applications increased mothers' knowledge about stimulating child growth and development (p=0.001).

Conclusion The application implementation shows a significant increase in the knowledge of mothers with children aged 2–5 years.

Keywords Children; Growth; Growth and Development; Education; Methods

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Introduction

Childhood is a crucial stage of the development process in human life. It is associated with the assumption that childhood is the earliest period in life that will determine subsequent developments [1, 2]. In addition, this is the most critical period in forming character or personality [3, 4].

Every child is unique and has a different pace of development [5]. The time range for achieving each stage of development is extensive. For example, a child is average if he can walk from 10-18 months. There are often differences in development between children of the same age [6].

Developmental delays in children are still a serious problem in both developed and developing countries [4, 7]. The prevalence of toddlers with developmental disorders is 28.7%, and Indonesia is the third country with the highest prevalence in Southeast Asia [8]. Research states that children in 54 developed countries show some symptoms of anti-social behavior disorder, which can develop into behavioral disorders later in life [9]. In Thailand, it reaches 37.1% [10]. In India, the prevalence of global developmental delays assessed by Ages and Stages Questionnaires (ASQ) was 19.8%, personal-social delays 42.5%, gross motor skills 38.1.1%, and problem-solving skills (34.9%) [11]. In 2017, the overall prevalence of developmental delays was 7.9% [12]. In Mongolia, it was 25.8% of toddlers aged 9 months to 5 years [13].

Developmental delays at an early age have adverse effects in the future, as stated by Piccolo *et al.* [14], where delays in neuro psychomotor development at the age of 4 years are associated with the delayed development of IQ and visual-spatial abilities in school age. Children who experience delays in speaking and language will result in difficulties in understanding learning. Adolescents with language development disorders will have higher anxiety levels than their friends who do not experience it [15]. Studies indicate the urgency of implementing interventions to reduce the prevalence and impact of delayed growth and development of toddlers [16, 17]. According to health behavior theory, there are three main focuses, including health maintenance, health restoration, and health improvement, through three levels of prevention: primary prevention, secondary prevention, and tertiary prevention [18]. These actions can be implemented at the individual, interpersonal, organizational, community, and public policy levels. Anticipation of delays in the growth and development of toddlers can be done at all levels of prevention and implementation [19, 20].

Previous literature reviews on eight articles regarding toddler growth and development interventions found that the types of strategies used were mainly in the form of home visits or parental education, which had an impact on a toddler or child's development [21–23].

Many studies have analyzed the use of technology applications in assessing the growth and development of toddlers. The research design used in the current research is applied research in which a computer-assisted expert system is applied regarding monitoring the growth and development of infants/early children [24]. This study is a design of an Android-based toddler growth and development monitoring application. This system is made to change the manual system to a computerized system using a database. Previously, data was in the form of a card; now, all data on toddler growth and development, as well as immunizations/vaccinations, are adequately stored in the database, thus preventing data loss and being more efficient because it can be accessed via a smartphone. This android application provides information and facilitates users in monitoring the growth and development of toddlers [25].

Developing technology and multimedia has a tremendous impact on educators exploring learning methods and media. The features of the multimedia learning platform form the foundation that makes technology-based learning facilities essential for effective learning. It is consistent with the cognitive theory of multimedia learning [26]. The potential for developing learning media through technological developments and advancements in educational platforms is widely open to its developers. Currently, the use of smartphones is used by most people as a means to communicate or to search for specific information [27].

In the conventional educational approach, knowledge is given to students in a way that is sometimes boring and makes them lose interest in the whole process. The development of this educational model is based on an android application called "Si_Edu", which contains knowledge about growth, development, and stimulation. The application is equipped with steps to conduct assessments and determine stimulation according to the toddler's age. The development of the application model using application technology follows current technological developments where most people already use Android. Hence, obtaining needs, including knowledge and information, makes it more accessible.

This study aimed to design and develop an educational model to guide mothers of children 2–5 years old to increase their knowledge and skills about assessing growth, development, and stimulation of child development.

Materials and Methods

Study design
The current study used a quasi-experimental design with a two-group pre-test-post-test approach.

Setting of study
This study was carried out at the Aurdauri Public Health Center, Jambi City, Jambi Province, Indonesia, in May – November 2022. The Aurdauri Health Center has the most comprehensive working area coverage in Jambi City, with a relatively high area density. The location of this Puskesmas is also easy to reach because it is in the middle of the economic center of Jambi City, so mothers will not mind visiting the Puskesmas to get health services, especially children's health services. Activities related to child health services at the Aurdauri Health Center are going well, with a relatively high number of visits. This study was carried out with the assistance of maternal and child health service staff from the Aurdauri Health Center. It was also carried out as a form of promotion to staff regarding this educational application.

Participant
The subjects in this study were 31 mothers of children aged 2–5 years old who were randomly selected with the criteria of being able to use Android properly. In contrast, mothers of children 2–5 years old who were sick were excluded from this study. The number of mothers who visited the Aurduri health center when this research was conducted was 35 people; then, they were selected based on inclusion and exclusion criteria. The research subjects were mothers of children 2–5 years old, totaling 31 mothers who were distributed into small groups (n=15) and large groups (n=16). For small groups, the application was carried out by participants accompanied by researchers, while for large groups, participants used the application independently without assistance from researchers.

Sample size
The sample size was determined using the Slovin formula. The study population consisted of 35 mothers with a precision value (d) = 0.05, so a total sample of 31 mothers was obtained.

Study procedure
The research procedure refers to the Research and Development model by ADDIE [28]. This research develops educational videos about assessing growth, development, and stimulation of child development. The research and development procedure consists of two main objectives, including developing a product and testing the feasibility of the product. The first main objective is referred to as the development function. In contrast, the second is referred to as the validation function.

This research analyzes the needs of mothers under the age of five to find out the experienced learning problems, and then by intervening in the form of educational media products on measuring the growth, development, and stimulating the growth of the child, it seeks ideas or solutions for these problems. The steps of this research were as follows:

1. Need analysis
The first step was a needs analysis to determine the goals of what the participants wanted after learning. Data collection was carried out through interviews with 11 mothers of children 2–5 years old (eligible participants mixed small and large groups).

2. Development of learning materials
Development and selection of materials and products included instructions for product use (product manuals), growth and development materials, stimulation appropriate to the age of 2-5 when an assessment is carried out, and warning notifications for mothers to carry out growth and development assessments. The trial of the android application involved three mothers randomly selected from the small and large groups to find out the response of these mothers to the application that had been developed.

3. Design and development of formative evaluations
Time to design and develop formative evaluations was obtained through assessment instruments or questionnaires used to collect the data. The data obtained was used as a consideration in revising the development of learning or teaching material products in the form of Android-based applications. The formative evaluation included expert validation (material and media experts) and small group trials (n=15).

4. Design and development of summative evaluation
Field testing in large groups involving 16 mothers under five was conducted to improve the product's structure, function, and user behavior. Currently, there is no interaction between users and researchers to test whether the product can operate adequately without the researcher's presence. A procedure manual for using the product was provided to users. The test used a one-group pretest-posttest experimental research design.

Data collection
Data collection was carried out by distributing questionnaires to participants about assessing growth, development, and stimulation of child development and obtaining validation data from media and material experts. Questionnaires were given to the validator to validate data about the

characteristics of the educational media that had been developed. Direct interviews were conducted with instructors regarding the development of educational videos. Questions focused on assessing growth, development, and stimulation of child development.

The mother's knowledge was assessed using a questionnaire consisting of 20 questions about toddler growth and development. The Likert scale was used with a score range of 1-5 with details; if the mother answered that she strongly agreed was given a score of 5; if agreed was given a score of 4; undecided was given a score of 3, disagreed was given a score of 2 and strongly disagreed was given a score of 1.

Data analysis

Data were presented as numbers and percentages for numerical variables. Continuous data were expressed as mean, then bivariate analysis was done using the paired t-test. The paired t-test was used to compare the mother's knowledge before and after the intervention using the android application media regarding the stimulation of toddler growth and development. All tests with p-value <0.05 were considered significant. Statistical analysis was performed using the SPSS 16.0 application.

Findings

The results of the research at each stage of the development of the Dick and Carey model are as follows:

1. Need analysis

As an initial step in application development, the needs of the target participants were analyzed. After the interview, it was found that most of the mothers (82%) could not differentiate between

growth and development, 82% knew about growth stimulation, 91% wanted to know about growth and development stimulation, and 90% preferred audiovisual information (Table 1).

2. Development of learning materials

This stage produced a storyboard to design an educational application to stimulate children's growth and development, with an initial display like Figure 1.

Figure 1) The opening scene of the storyboard development of an educational model to stimulate the growth and development of 2-5-year-old children

3. Design and development of formative evaluations

There were 12 item assessment indicators by material experts with a total score of 58 and an average of 4.8, with the conclusion of the application in the very good category (Table 2).

Table 1) Need analysis

No.	Question	Answer (%)	
		Yes	No
1	Are there any obstacles in caring for the health of children?	45	55
2	Steps have been given to improve the health of children.	27	73
3	Can you tell the difference between children's growth and development?	18	82
4	What does it take to increase children's growth?	72	28
5	What is needed to improve the development of children?	18	82
6	What is meant by the growth and development of children?	18	82
7	Have you ever provided stimulation for your children's growth and development?	18	82
8	Are your children currently growing well?	72	78
9	Are your children currently developing well?	27	83
10	What do you want to know about children's growth, children's development and stimulation of growth and development?	81	19
11	Do you know the Maternal and Child Health Program from the Government?	45	55
12	Sources of information that have been obtained regarding the growth and development of children and their stimulation (Books, Youtube, IG)	18	82
13	What kind of media or sources make it easier for mothers to receive and understand information about the growth and development of children and their stimulation? (Audiovisual, Handphone)	10	90

Computers and programming were assessed by media experts to get input about the feasibility of applications that have been developed. The assessment results obtained an average of 4.7 (very good category), and the advice was to add videos according to the material to make it easier for users to understand (Table 3).

Table 2) Material expert validation

No.	Statement	Score				
		1	2	3	4	5
Material aspect						
1	Material suitability with the concept of growth and development				√	
2	The truth of the concept					√
3	The order of presentation of the material					√
4	The images used are in accordance with the material.					√
Educational aspect						
5.	The material is suitable for educational purposes.				√	
6	Content clarity					√
7	Indicator clarity					√
8	The suitability of the images given to clarify the material					√
9	The use of each material					V
Communication aspect						
10	Term accuracy					√
11	Grammar accuracy					√
12	Ability to increase user motivation					√
Total score		58				
Mean		4.8 (very good category)				

Table 3) Media expert validation

No.	Statement	Score				
		1	2	3	4	5
Programming aspect						
1	Menu					√
2	Instructions for use				√	
3	Ease of use					√
4	Completeness				√	
Display aspect						
5	Letter					√
6	Distance use					√
7	Text readability				√	√
8	Picture					
9	Layout					
10	Navigation Keys					√
11	Colour					√
12	Interpage presentation					√
Total score		47				
Mean		4.7 (very good category)				

The small group trial was carried out on 15 mothers of 2–5 years old children, and all participants were able to use the application and said they enjoyed using it. There was a significant difference between knowledge before and after using the application (p<0.05), with a mean difference of 21.4 (Table 4).

4. Design and development of summative evaluation

In the large group, there was a significant difference between knowledge before and after using the application (p<0.05), with a mean difference of 16 (Table 5).

Table 4) Comparing the mean score of knowledge before and after using educational applications to stimulate the growth and development of 2-5-year-old children (small group, n=15)

Knowledge	Mean±SD	Min-max	t	df	Sig.
Pre test	57.30±10.25	45-78	-11.495	14	0.001
Post test	78.70±9.82	60-90			

Table 5) Comparing the mean score of knowledge before and after using educational applications to stimulate the growth and development of 2-5-year-old children (large group, n=16)

Knowledge	Mean±SD	Min-max	t	df	Sig. (2-tailed)
Pre test	57.00±10.89	40-79	-11.548	29	0.001
Post test	73.00±12.01	55-93			

Discussion

The development of this stimulation model is the design of intervention products using the Dick and Carey intervention design model, where Android-based guidelines for assessing the growth and development of 2–5 years children are used to make the education process and skills improvement more accessible and more attractive [29, 30]. The Dick and Carey learning model was developed through a system approach to the essential components of learning system design, including analysis, design, development, implementation, and evaluation [31–33]. The learning system model developed by Dick *et al.* consists of several components that must be carried out to design more extensive learning activities [19, 34, 35]. Dick and Carey's model includes cognitive and behavioristic elements emphasizing students' responses to the presented stimulus. Implementing this learning system design model requires a comprehensive systematic process [33]. It is necessary to create a learning system design that can be used optimally to overcome learning problems [36, 37].

In the first stage, it is vital to analyze the substantive needs regarding the growth and development of children aged 2-5 years through the mother's perspective. Most mothers could not distinguish between child growth and development and greatly desired to know more about this problem. Mothers also expect to be educated about the child's growth and development but prefer to be educated using audio-visual methods. In recent years, along with the rapid development of technology, people's interest in textbooks or writing without inserting pictures has decreased drastically. Nowadays, it is easier to understand received information when it is

accompanied by pictures or videos that can emphasize gestures [38]. In a study conducted in Indonesia, mothers who were given education using audio-visual media experienced a significant increase in knowledge about caring for children with pneumonia [39].

Based on the evaluation of the application by media and material experts, the growth and development application is suitable for use without any revisions. Meanwhile, the test results from users with good category values and interesting application comments make this application applicable to learning in pediatric nursing courses. In developing an application, the involvement of experts is crucial to assess the feasibility of the content and features available to achieve the expected results and avoid biased conclusions from subsequent data analysis. There are two components assessed by experts, including material and media. Experts assess the material in the application regarding child development in the field of child health to maintain its suitability with the educational theme, user needs, and user acceptance. For media assessment, one information technology expert provides an assessment of the application developed based on the assessment format that the author has shared. Generally, this application is easy to use, with an attractive appearance. Ease of use of the application is one of the determinants of interest for the frequency of its use.

In the summative evaluation, the statistical value indicates a significant difference in the level of the mother's knowledge before and after the audio-visual media-based intervention. These results provide an accurate picture of the potential use of audio-visual media to support educational efforts for mothers or the community in general. Supposedly, this study's results can increase health educators' confidence to consider the use of innovative media, such as audio-visual, tailored to the target's abilities. In line with several previous studies, most of the education that was carried out with the help of audio-visual media showed satisfactory results where the knowledge of the target participants significantly increased [40, 41]. In addition, the use of audio-visual media increases the enthusiasm and interest of students to learn the material provided by lecturers. However, it is also recognized that textbooks need to be combined with other teaching media [42–44].

The use of multimedia in the teaching and learning process aims to improve the quality of teaching and learning; with the development of multimedia technology, video, sound, text, and graphic elements can be packaged into one application. The purpose of implementing learning using multimedia is to replace and complement the goals, materials, methods, and assessment tools that exist in the teaching and learning process in conventional learning systems. It is expected that the use of this multimedia will change the learning environment, positively affect the emergence of motivation, especially in participation in learning, and then increase the learning outcomes of students.

The development of multimedia technology has offered great potential to change the way a person learns, obtains information, and adapts information. Multimedia also provides opportunities for educators to develop learning techniques to provide maximum results. Likewise, with the use of multimedia, it is hoped that it will be easier to determine how students can absorb information quickly and efficiently. Sources of information are no longer focused solely on the book's text but are broader than that. The ability of multimedia technology connected to the internet will further add to the ease of obtaining the expected information.

For this reason, this study can add to and be a reinforcement for professional educators to make choices in delivering education to the broader community. Even more, especially for groups of mothers who have children aged 2-5 years. The results of this study also open up comprehensive recommendations for further investigations that can be carried out in this area by comparing them with several other learning media and with a more significant number of target participants to obtain results with higher accuracy.

Since this was a development study, we could recruit only a small number of samples because it was in a small area. For this reason, future studies can apply this educational model with a larger and broader sample size by considering several variables from the characteristics of mothers and children.

Conclusion

This development model is in the form of an Android-based growth and development stimulation application called "Si_EDU". The application implementation shows a significant increase in the knowledge of mothers of 2–5 years children after using the application.

Ethical Permission: No economic incentives were offered or provided for participation in this study. The study protocol matched the Declaration of Helsinki's ethical guidelines for clinical studies. This research has been approved by the Health Research Ethics Commission of the Health Polytechnic of the Jambi Ministry of Health with registration number: LB.02.06/2/145/2022

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