



Development of Android-Based Physical Education E-Module Teaching Materials for Elementary School Floor Gymnastics Material

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Abstract

Physical Education (PJOK) plays a crucial role in the holistic development of students, encompassing physical, mental, emotional, and motor aspects. However, its implementation in Indonesia faces challenges such as limited infrastructure, a lack of trained teachers, low priority, and minimal student interest in certain materials, such as floor gymnastics. This study aims to develop an interactive Android-based e-module for floor gymnastics for fifth-grade elementary school (Independent Curriculum Phase C) to improve understanding and motivation to learn. The method used is Research and Development (R&D) with the ADDIE model (Analysis, Design, Development, Implementation, Evaluation). Validation was carried out by three experts (materials, learning, and media), followed by small-scale trials (40 students) and large-scale trials (84 students). Data were collected through interviews, questionnaires, and documentation, analyzed using Aiken V (average score 0.88, very valid category) and Cronbach's Alpha (0.836, reliable). The feasibility test results showed very high scores from teachers (90.4% small test; 92% large test) and students (89.43%; 90.4%). The final product in the form of an e-module with video demonstrations of movements and interactive quizzes, was used by: (1) PJOK teachers as a teaching aid, (2) students for independent learning with repeated video guides, and (3) parents in accompanying learning at home. This study proves that the developed e-module is valid, reliable, and feasible as an innovative solution for learning floor gymnastics.

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INTRODUCTION

Education is essentially a basic human need that plays a crucial role in improving the quality of human resources and serves as the primary foundation for realizing a more advanced and prosperous nation. Education is a crucial component in shaping a new, high-quality generation (Fahmi et al., 2021). More than just a formal activity, education is fundamentally an effort to humanize people through the process of cultivating and ennobling human values (Izza et al., 2024). This process is realized through teaching and learning interactions between teachers and students, aimed at developing the full potential of students (Muhardini et al., 2023).

Physical education plays a vital role in the education system because it aims to optimize the overall development of students, encompassing physical, mental, emotional, and motor skills (Supriyadi, 2016). Physical education provides students with the knowledge, skills, and confidence to be physically active throughout their lives (Michael et al., 2021). The main goal is to develop various aspects such as physical fitness, motor skills, critical thinking skills, social skills, emotional stability, moral actions, and healthy lifestyles (Ananda Muhamad Tri Utama, 2022).

Although the implementation of Physical Education in Indonesia is regulated by Law Number 11 of 2022 and Law Number 20 of 2003 on the National Education System, its implementation in the field still faces various challenges. The gap between regulation and practice arises from several factors, including limited sports facilities, inadequate infrastructure, and a lack of trained teachers (Putro et al., 2024).

Physical Education, Sports, and Health (PJOK) encompasses a broad range of subjects within the school curriculum, encompassing various essential components, including games and sports, developmental activities, gymnastics, rhythmic activities, water activities, out-of-class education, and health. Among these subjects, floor gymnastics is one of the most challenging to teach. According to (Syafei et al., 2023), in addition to its high level of difficulty, floor

gymnastics is also less popular among students. This is due to several inhibiting factors, such as trauma from injuries experienced by students when performing incorrect movements (Septiana et al., 2022).

Learning floor gymnastics isn't just about practicing physical movements; it also requires a thorough understanding of theory. Students need to master correct techniques, safety principles, and the benefits of each movement to prevent injury and understand physical activity effectively. However, many schools face a lack of adequate teaching materials. This makes it difficult for teachers to deliver the material and can diminish student interest in physical education.

One solution to address this problem is to provide innovative and engaging learning materials for students. (Khoirul Fikri & Firmansyah Sofianto, 2022) stated that implementing innovative learning materials with maximum utilization can create a more efficient learning environment. This shows that learning materials are a very important component in facilitating the learning process. Therefore, educators must create innovative and engaging learning materials in accordance with developments in the era of industry 4.0, all of which have used digital technology (Sugianto et al., 2023).

With the development of technology, teaching materials are no longer limited to books, but can also be obtained from the internet or other sources such as journals, articles, electronic books (e-books), and electronic materials (e-modules), making it easier for students to access materials. With advances in science and technology, various types of more engaging learning media have also developed and can be used at school and at home. One example is the e-module. According to (Romayanti et al., 2020), e-modules are not only effective in increasing student participation but also capable of replacing printed teaching materials without compromising the quality of the information conveyed. In principle, the development of e-modules actually adopts the same components as conventional printed modules (Mahardika, 2022).

Researchers conducted a needs analysis of elementary school physical education teachers in Moga District, Pemalang Regency, on May 21,

2025). The preliminary study results showed that although 100% of respondents stated that they had used floor gymnastics teaching materials in their lessons, 81.25% stated that the availability of these teaching materials was still inadequate. Only 18.75% considered the existing teaching materials sufficient. Furthermore, 93.75% of teachers stated the need to develop teaching materials in the form of e-modules to improve learning effectiveness. These findings indicate an urgent need for higher-quality teaching materials to support the teaching and learning process. In line with this, the development of e-modules is considered an appropriate solution to create more interactive and effective learning (Erniwati et al., 2022).

One form of innovation that can be implemented is an Android-based e-module, which offers the flexibility of self-learning while increasing learning interactivity (Husna et al., 2025). Android applications provide an open platform for users and developers to create various forms of applications as desired (Siregar & Fahrian, 2024). The interactive and adaptive nature of Android-based e-modules, which can be used for online and offline learning at any time and from any location, makes them superior to printed modules (Wati & Putra, 2023). One software that can be used to make e-modules more attractive is Flip PDF Corporate (Hamdani et al., 2022).

The development of e-module teaching materials for elementary school floor gymnastics already exists, namely research by Noor Akhmad Hidayat, Herwanto and Rofi'i (2024) entitled "Development of Learning E-Modules with the SAVI Model on Floor Gymnastics Material for Grade 5 Phase C of the Independent Curriculum" with a feasibility test result of 91.3% falling into the very good category. The results of the user interest level assessment test obtained a score of 90% falling into the very interesting criteria. However, the study only involved 15 students from one school (SDN 008 Waru, East Kalimantan), so the findings cannot be generalized to a wider population. In addition, the E-module requires internet access, which may not be affordable in schools with limited facilities. There is no alternative offline version. Therefore, the researcher wants to develop a detailed e-module for floor gymnastics that can be accessed

by students both online and offline. Based on the background description above, the researcher is interested in developing an Android-based e-module teaching material with the title "Development of Android-Based Physical Education E-Module Teaching Materials on Elementary School Floor Gymnastics Material". The focus of this research is fifth grade elementary school students because they are in Phase C of the Independent Curriculum, where mastery of dominant movements is highly emphasized.

METHODS

This research uses the R&D (Research and Development) approach. Kadek Aris Priyanthi, Ketut Agustini (2017) stated that the research and development method, or in English called Research and Development, is a type of research that aims to produce certain products and test the effectiveness of these products (Aryawan et al., 2018). Meanwhile, according to Sugiyono, (2015) research and development is a method used to create certain products and test their effectiveness (Andava & Reinita, 2023).

This research adopts the ADDIE model, which consists of five stages: Analysis, Design, Development, Implementation, and Evaluation. According to Rayanto & Sugianti (2020), the ADDIE model is an approach that emphasizes analyzing the interactions between each existing component, with coordination according to the specified phases. This development model can serve as a guideline for creating effective products because its stages are simple and include detailed explanations of the components.

The first stage was analysis. In this stage, researchers analyzed the teaching materials needed by teachers and fifth-grade elementary school students. The needs analysis used was through observations of elementary school physical education teachers. According to Wulandari and Purwanto, (Malahayati & Zunaidah, 2021), needs analysis is the process of searching for or collecting information regarding expected needs as a basis for developing a product.

The second stage is design. This design stage is the process of creating a teaching material

plan that focuses on floor gymnastics for fifth-grade elementary school students. In this stage, researchers strive to create teaching materials that are not only informative, but also engaging and easy for students to understand. Researchers used the Flip PDF Corporate application and the Website 2 APK Builder application to design the e-module product and its media. With this application, researchers can integrate text, images, and videos, so students can learn in a more interactive way.

The third stage is developing a product that has been designed. At this stage, the resulting product goes through a validation process by material experts, learning experts, and media experts. Aspects that are validated include the design of teaching materials, pedagogy, development principles, teaching materials, and the message that will be conveyed through the product. The prototype that has been designed and built requires input for improvement both conceptually and practically. Conceptual aspects that need to be validated by the expert team include: (1) Learning design aspects, (2) Pedagogical aspects, (3) Principles of product development, (4) Physical concept of the product, (5) Teaching materials and messages that will be conveyed through the teaching materials.

After conducting a validity test and the results show good criteria, the next step is implementation activities, which include:

- a. The first stage involves conducting a small-scale trial to assess the feasibility of the developed product. This involves displaying the floor gymnastics e-module. After receiving feedback from physical education teachers and students using a questionnaire to assess the product, the next stage will be revisions and a large-scale trial.
- b. The second stage is conducting large-scale tests which have the same aim as small-scale tests, but at this stage more subjects are used.

The final stage that researchers must undertake is evaluation. ADDIE model evaluation is divided into formative and summative evaluations. At this stage, researchers conduct formative evaluation, which is the evaluation conducted to collect data at each stage

with the aim of improving teaching materials. Meanwhile, summative evaluation is a comprehensive evaluation of the development process and the impact obtained from product use.

The research will be conducted at SDN 01 Mandiraja on a small scale, while the larger scale will be conducted at SDN 01 Sima, SDN 02 Sima, and SDN 06 Sima in Moga District, Pemalang Regency. The researchers selected grade 5 as the target in this study.

The data collected in this study consisted of qualitative and quantitative data. Qualitative data were obtained through in-depth interviews with Physical Education teachers. The purpose of these interviews was to gather information regarding learning needs and challenges faced when teaching floor gymnastics in elementary schools. Quantitative data were obtained through questionnaires assessing learning models by media experts, material experts, learning experts, and questionnaires by teachers and students.

Data collection techniques in this study consisted of interviews, questionnaires, and documentation. The interviews in this study consisted of structured and unstructured interviews. These interviews were conducted with elementary school Physical Education teachers. Structured interviews use a list of questions or guidelines that have been prepared beforehand. Meanwhile, unstructured interviews do not have prepared questions, and usually occur when there are other things that need to be asked based on the respondents' answers in the structured interviews. The questionnaires in this study included an expert validation test questionnaire and a teaching material feasibility questionnaire. The validation test questionnaire was used to collect data regarding the product validation value. This questionnaire was distributed to validators, consisting of material experts, media experts, and learning experts to be filled out. The feasibility questionnaire was distributed to Physical Education teachers and students during the product trial phase. This questionnaire aims to provide information regarding the feasibility level of the teaching materials that have been developed. The

documentation stage is the process of collecting information by taking pictures while the researcher is conducting research activities.

Data analysis in this study includes questionnaire data analysis techniques. The questionnaire on the need to develop e-module floor gymnastics teaching materials for teachers was analyzed using descriptive statistics, namely a method of processing data that is carried out by systematically arranging it in the form of numbers and percentages regarding the object being studied, so that general conclusions can be obtained.

$$P = \frac{\text{Jawaban responden}}{\text{Skor maksimum}} \times 100\%$$

Information:

P : Percentage

The assessment of the validation questionnaire by material experts, learning experts, and media experts was analyzed using the V aiken analysis technique calculated using the following formula:

$$V = \sum S / [n(c-1)]$$

Information:

V : Rater agreement index

S : The score assigned by each rater minus the lowest score in the category

n : number of raters

c : the number of categories that the rater can choose from

The scores that have been generated are converted into the form of an Aiken V category table. The category table is presented in the table

Table 3.1 Aiken Criteria V

Score	Category
$0.80 < V \leq 1.00$	Very high
$0.60 < V \leq 0.80$	Tall
$0.40 < V \leq 0.60$	Enough
$0.20 < V \leq 0.40$	Low
$0.00 < V \leq 0.20$	Very Low

A feasibility test questionnaire was administered to teachers and students during the implementation phase. Data from this questionnaire was used to assess the product's suitability as a floor gymnastics e-module teaching material. The questionnaire had five answers, as shown in the following table.

Table 3.2 Answers to the Feasibility Test Questionnaire

Answer Options	Score
SB (Strongly Agree)	5
S (Agree)	4
TT (Disagree)	3
TS (Disagree)	2
STS (Strongly Disagree)	1

(Sugiyono, 2019:93)

The assessment of the teaching material feasibility test questionnaire is calculated using the following formula.

$$P = \frac{\sum x}{\sum x1} \times 100\%$$

Information:

P : Percentage

$\sum x$: total score of all respondents' answers

$\sum x1$: total maximum score in the entire instrument

Table 3.3 Eligibility Criteria

Score in Percentage	Eligibility Category
81% - 100%	Very Worthy
61% - 80%	Worthy
41% - 60%	Quite Decent
21% - 40%	Not feasible
<21%	Totally Unworthy

RESULTS AND DISCUSSION

1. Analysis

Interviews with fifteen Physical Education teachers from various elementary schools in Moga District revealed several key findings regarding the need to develop digital teaching materials for floor gymnastics. The most frequently cited issue was limited facilities and infrastructure, with ten of the fifteen respondents stating that facilities such as mats and supporting equipment were minimal. This situation makes the learning process less than optimal and increases the risk of injury to students. Several teachers also noted that many students exhibited fear and a lack of confidence when it came to practicing floor gymnastics movements.

"We only have one mat for a class of 30 students. This is clearly not ideal for safe and effective learning," said one teacher. Another

issue faced is the limited availability of teaching materials, with most schools relying solely on physical education teacher's guides, which are considered uninteresting and lack adequate visualization.

In response to this situation, all the teachers interviewed welcomed the plan to develop an Android-based floor gymnastics e-module. They believe this digital teaching material can provide a solution to various problems they face. "With an e-module equipped with demonstration videos, students can more easily understand the basic movements before practicing them in class," explained one teacher.

1. Design

In this design phase, researchers developed a systematic framework for developing a well-structured teaching material product. The initial stage began with the creation of an attractive cover design featuring visual illustrations of children performing gymnastics movements, complete with a clear title and basic information about the module. Following the cover page, a foreword was written explaining the purpose of the module and its benefits for learning. This section also included acknowledgments to the various parties involved.

This e-module features an intuitive navigation menu that allows users to easily access various sections. Instructions for use are presented visually with clear icons and brief explanations of how to utilize the module's key features. The next important section presents learning outcomes and objectives formulated specifically in accordance with the physical education curriculum for fifth grade elementary school. The core material focuses on four basic floor gymnastics techniques in accordance with the curriculum: forward rolls, backward rolls, candle poses, and cartwheels. Each movement is accompanied by an explanation of the movement sequence, images, demonstration videos, and examples of common errors.

This e-module also provides interactive quizzes with various question types and answer keys. The bibliography is academically structured to show the references used, while the developer's biodata is included for accountability.

2. Development (Development)

The e-module, which had been designed and saved in PDF format, was then converted into interactive digital teaching materials using Flip PDF Corporate. The process began by importing the PDF file into the software. The researcher inserted audio recordings explaining each basic floor exercise movement, as well as demonstration videos demonstrating correct technique and common mistakes to avoid. To enhance interactivity, various navigation buttons were added to each page of the e-module, such as back, forward, and quick menu buttons. The official e-module logo was consistently displayed in the header as a visual identity. Further adjustments were made to the appearance of the interactive buttons, including adjusting the size, color, and position for ease of use by elementary school students. After all refinements were completed, the e-module was exported in HTML5 format, ready to be converted into a mobile application.

The next step is to convert the HTML5 e-module into an Android application. Researchers open the Website 2 APK Builder platform and enter the source material with two options: (1) upload the HTML5 file directly to the platform, or (2) enter the URL if the e-module is already hosted on an online server. In the customization stage, the application is given a descriptive name such as "E-Modul Senam Lantai" (Floor Gymnastics E-Module), as well as an attractive application icon that is relevant to the content. After the APK build process is complete, the application file in .apk format is then transferred to the Android device via various methods such as a data cable, Bluetooth, or cloud storage. The application is ready to be installed and tested on various devices with different Android versions, ensuring good compatibility and functionality before being distributed to end users.



Figure 4.1 Application icon display

Android-based e-module teaching materials were validated by experts before being tested on students. This validation process was used to ensure that the learning materials were valid and usable by students. The validity test was carried out by material experts and learning experts who were certified Physical Education teachers. Meanwhile, media experts were certified Computer and Network Engineering teachers. Learning experts. Material experts, media experts, and learning experts included Karmanto, S.Pd, Agung Wicaksono S.Pd, M.Pd, and Teguh Ari Wibowo S.Pd. In the assessment process on the validation sheet, the validator also provided comments and suggestions on deficiencies and errors that needed to be corrected in the e-module. The validation results and suggestions provided by the validator were used as a basis for revising and perfecting the developed e-module.

Table 4.1 Results of Aiken V Analysis of Expert Validation Instrument

Aspect	V	Category
Material Quality		
The material is presented in multimedia form (visual, audio, and audiovisual)	0.83	Very high
Interactive features (videos, simulations) make it easier to understand movement techniques.	0.92	Very high
The illustration is easy to see from various angles.	0.83	Very high
The learning design includes error detection and correction strategies (identifying and correcting movement errors) through visual/narrative examples.	0.92	Very high
Encourage students to learn independently	0.92	Very high
Ease of access		
Ease of operating the program	0.83	Very high
Clarity of media instructions	0.83	Very high

The e-module navigation is intuitive and easy for students to use.	0.83	Very high
Clarity of menus and buttons	0.83	Very high
Language		
The language used is easy for students to understand	0.83	Very high
The sentences used do not have double meanings	0.92	Very high
Conformity with good and correct Indonesian language rules	0.92	Very high
Writing		
Readability of writing	0.92	Very high
Don't use too many fonts	0.83	Very high
Accuracy of font size	0.92	Very high
The letters used are attractive and easy to read	0.92	Very high
The spacing between characters and lines is appropriate	0.83	Very high
Benefits		
Effective interactive quizzes for self-evaluation	0.83	Very high
Strengthening students' understanding of concepts	0.92	Very high
Media allows the use of teaching materials anywhere and anytime	0.92	Very high
Total	0.88	Very high

Of the 20 items that were validated, the average V value was found to be in the very high category with an average score of 8.8. This means that all items in the instrument were deemed valid for use. The instruments that had been tested for validity were then tested for reliability using SPSS 27. The following are the results of the reliability test for the expert validation instrument:

Table 4.2 Reliability Test Results

Reliability Statistics

Cronbach's Alpha	N of Items
.836	20

From the results of the reliability test, the Cronbach's Alpha value for the instrument was 0.836. According to Ghazali (2018), Cronbach's Alpha is acceptable if its value is more than 0.6.

3. Implementation

The next stage in the development process is to conduct a product trial with physical education teachers and student sports instructors. The purpose of this trial is to gather feedback from physical education teachers and students regarding the e-module teaching materials. This process will be carried out in two stages: a small-scale trial and a large-scale trial.

A small-scale trial was conducted on June 13, 2025, targeting one Physical Education teacher and 40 fifth-grade students. The analysis showed that in the small-scale trial involving one Physical Education teacher and 40 students, the e-module teaching material received very positive reviews. Specifically, teachers gave a feasibility rating of 90.4%, while students collectively gave an average score of 89.43%. These figures indicate that the e-module has met the criteria of being very suitable for use in learning.

The test subjects in this large-scale trial were three Physical Education teachers and 84 students who were tested at three schools: SD Negeri 01 Sima, SD Negeri 02 Sima, and SD Negeri 06 Sima, Moga District, Pemalang Regency. Quantitatively, the teachers gave an average feasibility assessment of 92%, while students gave an even higher score of 90.67%. These figures are not only consistent with the results of the previous small-scale trial, but even show an increase in quality. The percentage reaching above 90% from both groups of respondents firmly categorizes the e-module as a teaching material that is very suitable for use in learning.

4. Evaluation

The evaluation process in this study was conducted comprehensively through formative evaluation aimed at refining the product. This stage is crucial for identifying weaknesses and making improvements based on feedback from the validity and feasibility tests. The validators provided constructive suggestions that were implemented to improve the quality of the e-module. Regarding the media aspect, revisions were made by adding audio elements to the e-module, aiming to increase interactivity and facilitate user understanding. On the other hand, regarding the content aspect, improvements

focused on technical issues, particularly related to several "next" buttons that previously did not function properly. These interface improvements were made to make navigation smoother and more user-friendly.

CONCLUSION

This research has succeeded in creating an Android-based Physical Education e-module for floor gymnastics learning in fifth grade elementary school that meets high quality standards. The developed product not only presents floor gymnastics material interactively through videos and visual texts, but has also proven its reliability through validity tests by experts with an Aiken V score of 0.88 (very valid category) and a Cronbach's Alpha reliability of 0.836. In practical testing, this e-module received very positive responses from both teachers and students, with an average feasibility score above 89% in both small and large scale tests. Its main advantage lies in its ability to overcome the limitations of conventional teaching materials while facilitating flexible independent learning. These findings prove that the developed e-module is not only academically feasible, but also effective for use in daily learning.

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The active participation of fifth-grade students, who enthusiastically participated in every stage of the research, was key to perfecting this e-module. Their enthusiasm and honest

responses helped us create a product that truly meets user needs.

The author fully realizes that without the strong collaboration of the entire family of SDN 01 Mandiraja, SDN 01 Sima, SDN 02 Sima, and SDN 06 Sima, this research would not have achieved optimal results. Hopefully, the floor gymnastics e-module that has been developed can provide tangible benefits to the learning process at these schools and also serve as the beginning of ongoing academic collaboration.

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