



Preventing Stunting Through ‘*Pengenalan Tanaman Pangan Indonesia*’ Media to Introduce Local Food

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ABSTRACT

This study aimed to develop an AR book, PETANI (Introduction to Indonesian Food Plants), that can help teachers introduce local Indonesian food plants to prevent stunting. This research is a development project utilizing the ADDIE model, which comprises the Analyze, Design, Development, Implementation, and Evaluation stages. The subjects in this study included learning media experts, learning material experts, and 29 teachers from Banyuwangi Regency. The data collection technique used was a questionnaire administered during validation and user trials. The result of this research is that AR Book PETANI has been developed to the needs of children's knowledge about local food plants. Additionally, AR Book PETANI is reported to be highly feasible, with an average score of 97.05%, making it suitable for implementation in learning about local food crops at PAUD institutions. This research concludes that the AR Book, with a theme of local food, has been developed as a medium to help teachers introduce local food and prevent stunting. The study's results confirm the importance of utilizing augmented reality technology in learning media to support nutrition education and optimize the potential of local food as a strategy for preventing stunting from an early age.

INTRODUCTION

Health development aims to create healthy, intelligent, and productive human beings in order to sustain the nation's future development (Departemen Kesehatan RI, 2004). Optimizing health development is important, starting from an early age. During this phase of rapid development, proper nutrition is essential, particularly for the growth and development of children's brain cells (Karavida et al., 2019). Early childhood has unique nutritional needs and plays a crucial role in the stages of child development, including motor development for self-feeding, language skills for communication with caregivers, and the development of children's social skills (Reverri et al., 2022). Providing less nutritious or less balanced food will increase the risk of malnutrition in children (Utomo et al., 2024). If children's nutrition is not fulfilled properly, it is feared that children will experience malnutrition, which leads to stunting.

Malnutrition is a state of severe energy and protein deficiency (PEM) resulting from inadequate consumption of nutritious food and/or prolonged illness (Juliana & Aisyah, 2022). Children who have poor nutrition are prone to stunting, which leads to growth failure. As stated by Masluhiya and Soares (2023), stunting is influenced by four nutritional problems: weight faltering, undernutrition, underweight, and malnutrition. The incidence of stunting usually begins with weight loss or abnormal weight gain. This condition can affect the development of children because the body's nutrients are not balanced with their needs.

The incidence of stunted children is relatively high in Indonesia. According to the results of a



survey conducted by the Ministry of Health through the Indonesian Nutrition Status Survey (SSGI) in 2023, the incidence of stunting in Indonesia was 24.4% (Rokom, 2023). Upon closer examination, the incidence of stunting in East Java Province reached 19.2%. This high percentage makes East Java Province one of the provinces that receives the most attention in efforts to prevent and overcome stunting. The survey results show that one of the causes of growth and development disorders is the low quality of food (Husnah et al., 2022). For this reason, special handling is needed to help solve this problem, one of which is by optimizing natural resources in the form of local food.

Optimizing the use of local food or food available in the community is one alternative for overcoming limited family food access (Sutyawan et al., 2022). Providing local food is one of the efforts that can be undertaken in the community, given the ease of access to local food for low-income communities, which are the groups most affected by stunted child development. The introduction of local food to all components of society, including early childhood, is also critical.

The introduction of local food is a new piece of knowledge that needs to be imparted to children. So far, children have only tasted and tasted family food served at the dinner table without knowing its health benefits. In addition, the attractiveness of presentation, good taste, and ease of access make junk food a popular choice for children despite its minimal nutritional content (Romadona et al., 2021). Therefore, targeted stimulation efforts are necessary to enhance children's understanding. Stimulation of child development can use a variety of games and media (Komang et al., 2024). This research aims to develop learning media for introducing local food as a measure to prevent stunting in early childhood. The learning media developed needs to be chosen that are interesting and align with children's learning characteristics. Teachers, as educators, play a vital role as the primary source of knowledge, while children must accept and memorize the information provided (Taneo et al., 2024). Additionally, the learning media provided must be by the child's age of development, allowing for the achievement of learning objectives. One of the learning media that can be used is augmented reality-based media.

The use of technology in the learning process is expected to enhance the effectiveness and efficiency of learning, making it more engaging and interactive for students (Agustiniingsih et al., 2024). Along with technological advances, learning media innovation is key to supporting stunting prevention efforts, primarily through the introduction of locally packaged food that is interactive and contextually relevant. One approach that has proven effective is the integration of augmented reality (AR) technology in learning media, such as AR Books, which can increase children's interest, understanding, and involvement in the learning process about nutrition and local food (Bintang et al., 2022; Putri et al., 2021). Augmented Reality (AR) is a technology that combines two-dimensional and/or three-dimensional virtual objects with a real environment, projecting these virtual objects into the real world in real-time (Priyo, 2020). Without diminishing the direct experience, augmented reality can provide virtual information on top of the real world with continuous and implicit user control over viewpoint and interactivity. The use of augmented reality in learning can change the way educators interact with students, making learning more realistic compared to abstract experiences (Kesim & Ozarslan, 2012). By using AR technology in learning, children can actively participate, which in turn will increase their confidence level by presenting an innovative and fun environment for learning. Research indicates that the use of AR in nutrition education and stunting prevention offers a fun learning experience, facilitates children's understanding of abstract concepts, and fosters attachment to local culture (Putri et al., 2021; Umami et al., 2024; Yulia et al., 2018). In addition, although it takes longer in the development process, AR-based media is also considered very effective in increasing knowledge and attitudes toward balanced nutrition, both in school-age and early childhood, and makes it easier for teachers to manage more meaningful learning (Nurchayanti et al., 2024; Wandanissyika et al., 2024).

This research aims to produce an AR book, "PETANI" (Pengenalan Tanaman Pangan Indonesia), that will help teachers introduce local Indonesian food plants. Local food plants should be introduced in a fun way to capture children's interest in learning and understanding them. This research has novelty in the utilization of augmented reality (AR) technology as a medium for local food education to prevent stunting in early childhood. When compared to previous studies, most stunting education efforts still employ conventional approaches, such as counseling, training, or simple visual media like flashcards and flipbooks, but have not utilized interactive digital technology, such as AR (Irawan et al., 2022). Creative education is crucial for improving nutrition knowledge, but it is still limited to traditional print



and visual media (Malayati et al., 2024).

Meanwhile, some studies have begun to integrate AR into nutrition education and stunting prevention, but the focus is still limited. Research by Irawan et al. (2022) shows that the use of AR-based Food Card media (FCAR) can increase parents' understanding of nutrition and have a positive impact on the consumption of nutritious foods in early childhood. Another study by Melisa et al. (2024) developed an AR-based nutrition education application for the prevention of stunting in the First 1000 Days of Life. The results showed that AR media effectively increased the knowledge of women of childbearing age about stunting. In addition, research on the AR-based Assemblr Edu application also showed a significant increase in the knowledge of 'POSYANDU' cadres in stunting prevention material after training and mentoring using the application (Melisa et al., 2024). Another study has proven that the use of AR Books can significantly improve the knowledge and attitude towards balanced nutrition in school-age children (Soedarmadi et al., 2024).

METHODS

Research model

In this study, researchers employed a research model based on the ADDIE (Analyze, Design, Development, Implementation, Evaluation) framework. This research model was chosen because it is considered the most suitable model and can provide maximum benefits to the Development of AR Book FARMERS. The ADDIE model begins with the analysis stage. At this stage, researchers identify the field needs for local foods that prevent stunting. This is necessary to understand user needs related to the learning media. The analysis was conducted through a Forum Group Discussion (FGD) between the development team and stakeholders. This is followed by the Design stage, where the results obtained from the analysis process at the Analyze stage become the basis for researchers to design learning media. The content and components in the learning media are tailored to meet the needs of users. The results of the design stage are the basis for entering the advanced stage, namely Development.

The development stage involves creating and refining the product. To facilitate product implementation by users in the field, this learning media is equipped with a guidebook that contains the stages of using the resulting media. After the entire product has been developed, the product design must undergo the validation stage. The validation carried out in this study was media validation and material validation. Products that validators have validated then enter the implementation stage. The implementation process is carried out through user tests, specifically with teachers. The results of the implementation that has been carried out. In this study, the evaluation will be carried out to make improvements to the suggestions and results of implementing augmented reality-based learning media for introducing local food to prevent stunting. The evaluation used is formative evaluation and summative evaluation. The chart of Development in this study can be seen in Figure 1

Population and sample

This learning media development research involves subjects in two stages: the development stage and the implementation stage. Regarding the development stage, the research subjects involved include learning media experts, learning material experts, and teachers who serve as media users. Meanwhile, for the product implementation process, the subjects used are all PAUD teachers in Banyuwangi Regency. However, based on random sampling, the number of teachers used as samples in this study was 29 people.

Data collection method

To obtain data related to this research, a questionnaire was used to validate the material and media experts. Additionally, the questionnaire was administered during the user trial process.

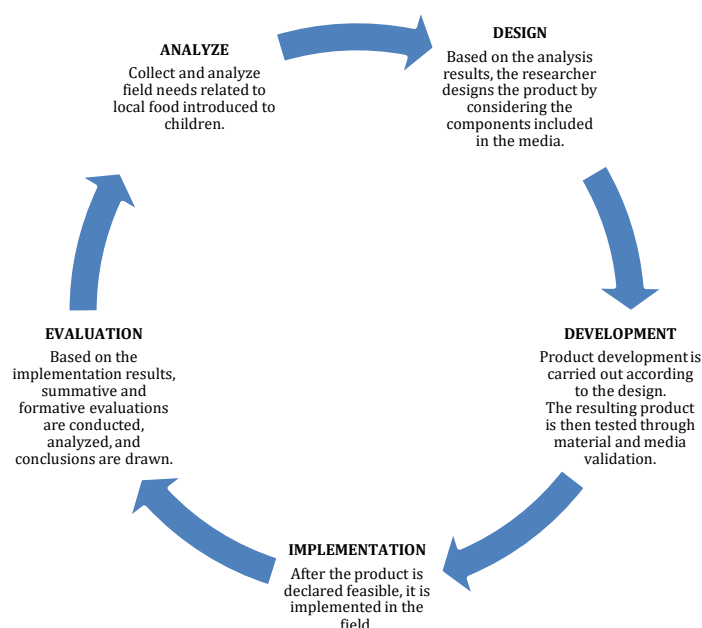


Figure 1. Flow chart of research implementation

RESULTS AND DISCUSSION

AR Book products are developed according to the needs of the field. By utilizing the ADDIE development model, this initiative aims to create innovative and relevant learning media that addresses current educational challenges, particularly in introducing local food to early childhood education. The primary purpose of developing this AR Book is to create learning media that is more interactive and engaging while making it easier for teachers to deliver material effectively. With this augmented reality-based media, it is expected that the learning process will not only be more engaging but also foster curiosity, creativity, and enthusiasm for learning from an early age. In addition, AR Book is also expected to strengthen the role of teachers as learning facilitators who are adaptable to technological developments, thereby enabling the continued improvement of early childhood education quality and supporting stunting prevention efforts through contextual and applicable local food education. The PETANI application product has been successfully developed and validated.

The analysis stage involves exploring field needs based on the results of observations. This process is necessary to ensure that product development aligns with the needs in the field. The field analysis stage involves conducting observations on the introduction of healthy food to early childhood at Siwi Becik Kindergarten in Surabaya.

The results of the analysis show that teachers have never introduced local food plants to children in an innovative way during learning. The introduction of food crops is often presented through pictures and short lectures, which reduces the attractiveness of the learning experience. In addition, the local food plants introduced by the teacher so far are only rice and cassava. Thus, the knowledge of local food among children is minimal.

Based on the analysis results, there is an urgent need to develop the PETANI application for early childhood. The PETANI app will discuss local Indonesian food plants in an interesting and fun way. By using this application, children will engage in active learning and acquire new knowledge.

The design stage can commence once the analysis stage has been completed. The design that has been developed encompasses both material design and media design. The material developed in this application is material about local Indonesian food plants that can help prevent stunting in children. The local food crops chosen are those commonly found in the community but are not fully recognized by children. In addition to rice and corn, the local food crops introduced through the PETANI application are cassava, sweet potato, taro, and potato. These crops are local food crops that are readily available but not widely recognized by children. The media design provided is that the PETANI application will



be developed as an application to introduce local food crops. The application will be assisted by a guidebook containing pictures related to the local food plants being introduced. This approach supports the findings of research indicating that the use of AR-based media can enhance the attractiveness and effectiveness of nutrition education (Malayati et al., 2024). The development of learning media with content tailored to children's age characteristics aligns with the principles of learning media utilization (Miftah & Rokhman, 2022).

At the Development stage, the PETANI application is developed using Assemblr Edu and Corel Draw software, which play an important role in producing attractive and interactive visualizations of local food crop images. The use of this technology allows the creation of educational content that is not only informative but also captivates the attention of early childhood, who are psychologically more responsive to visual stimuli and fun learning experiences (Nasrullah et al., 2018). The results of the development process in this study, which is referred to as Design I, are presented in Table 1.

In addition to producing products, in this stage researchers also created instrument which will help in the assessment of the FARM application. There are 2 types of instruments developed, namely product validation questionnaire and user test questionnaire. The grids of the questionnaires are in the Table 2 and Table 3.

Table 2. Material Validation Questionnaire

Validation	Indicator	Number of Items
Material	Suitability of Material to AUD	1,2,3,4,5
	In-App Content	6,7,8
	Aids Comprehension	9,10

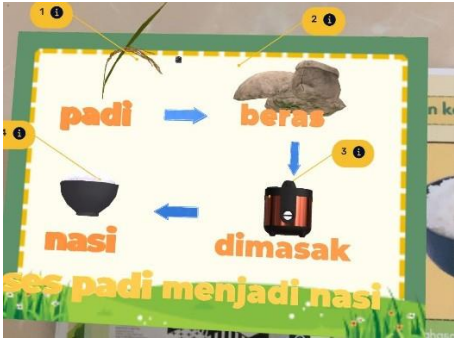
Table 3. Media Validation Questionnaire

Validation	Indicator	Number of Items
Media	Color Composition	1,2,3
	Image Suitability	4,5,6
	Appeal of the App	7

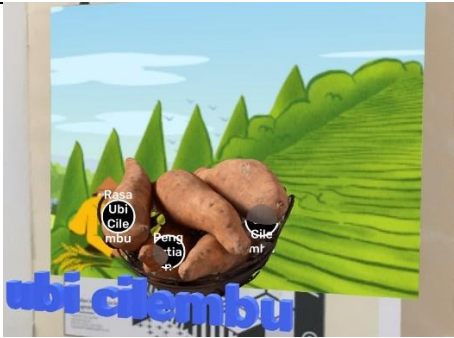
To test the feasibility of the Design I that has been produced, researchers conducted validation. There are two types of validation carried out, namely validation by material experts and validation by media experts. The results of the validation of the media and materials in FARM received the title "Very Feasible." This finding aligns with research on the development of educational media based on the ADDIE model (Rosita et al., 2024), which emphasizes that expert validation and user trials are crucial stages for obtaining constructive feedback while ensuring the suitability of content and media for user needs. In addition, research (Azizzah et al., 2024) also emphasizes that involving end users in product trials can improve the quality and acceptance of educational media developed, thereby facilitating its implementation in the field.

Furthermore, the use of software such as Assemblr Edu in the development of the PETANI application aligns with the trend of utilizing augmented reality (AR) in education, which has been proven to increase learning motivation and concept understanding in children (Irawan et al., 2022; Siti Azizzah et al., 2024). By presenting local food plants in a three-dimensional form that can be interacted with in real-time, this application not only enriches the learning experience but also helps children associate information concretely, which is crucial in early learning (Nasrullah et al., 2018). This is an advantage of the PETANI application over conventional educational media, which are often passive and less engaging.

Table 1. AR Book Design Results

No	Barcode	View
1.		
2.		
3.		
4.		



No	Barcode	View
5.		
6.		
7.		

In addition to technical and pedagogical aspects, the comprehensive validation process also assesses the appropriateness of the application in the local cultural and environmental context, specifically by introducing local food crops that are relevant and readily available in the community. This approach reinforces research results (Sutyawan et al., 2022) that highlight the importance of local food optimization as a sustainable strategy for preventing stunting. Thus, the PETANI application not only meets the quality standards of educational media in general but also has added value in the form of local relevance and technological innovation that supports the goal of effective stunting prevention.

Overall, the Development stage in this research demonstrates that the combination of AR technology, age-appropriate content design, and a validation process involving experts and users are key to the successful development of practical and applicable educational media. This aligns with best practices in modern learning media development, which emphasize the integration of technology, scientific validation, and user involvement as key factors for successful implementation in the field.

The implementation of the PETANI application for early childhood education teachers in Banyuwangi demonstrated that the application is practical as an innovative and interactive learning medium for introducing local food plants to early childhood education. This helps teachers provide positive stimulation, which is crucial during the cognitive and motor development stages of children while fostering their interest and understanding of food sources in their surrounding environment. This approach aligns with the research findings (Sutyawan et al., 2022), which confirm that optimizing the use of local food is an effective alternative strategy for overcoming limited family food access, as well as a sustainable effort to prevent stunting. By introducing local food plants from an early age, children



can become more familiar with naturally available and affordable nutritional sources, allowing them to form healthy consumption patterns from the start (Sutyawan et al., 2022).

The practicality of the PETANI application as augmented reality (AR)-based learning media is also very prominent in its implementation. The app is designed with a simple and intuitive interface, making it easy for early childhood teachers with varying levels of technological ability to operate. The use of standard devices, such as smartphones or tablets, which are already commonly owned by schools, makes this application accessible without requiring additional, expensive, or complicated hardware investments (Nasrullah et al., 2018). In addition, the PETANI app is equipped with clear navigation features and easy-to-understand usage guides, so teachers can quickly integrate the app into their daily learning activities without requiring intensive training (Rosita et al., 2024)

In practice, teachers can easily project live, interactive, three-dimensional images of local food plants into the classroom, allowing children to see, rotate, and interact with the virtual objects in real time. This creates an immersive and multisensorial learning experience, which is particularly effective for young children who are more responsive to visual and kinesthetic stimulation (Nasrullah et al., 2018). In addition, this application also provides content that can be customized according to individual learning needs, allowing teachers to organize materials based on the level of understanding and interest of each child. This practicality is also supported by the existence of an illustrated guidebook, which serves as companion material, making it easier for teachers to explain and reinforce the material conveyed through the application (Azizzah et al., 2024).

The use of AR technology in the PETANI application provides significant added value. AR technology enables the projection of local food crops in a real and interactive three-dimensional form, allowing children to learn actively and enjoyably through immersive visual experiences. The use of AR in learning can increase student motivation and engagement, which has a positive impact on concept understanding and information retention (Priyo, 2020). Other studies also support the notion that AR-based learning media can enhance the effectiveness of nutrition and health education, especially in early childhood, when children are more responsive to visual and kinesthetic stimulation (Irawan et al., 2022; Melisa et al., 2024). Thus, the PETANI application not only introduces knowledge about local food plants but also optimizes the learning process through technology that is adaptive to the learning characteristics of early childhood.

Overall, the implementation of the PETANI application makes a significant contribution to the development of innovative and contextual educational media, which not only supports stunting prevention efforts through nutrition education but also strengthens local food security by increasing awareness and utilization of existing food resources within the community. This approach is highly relevant to the needs of early childhood education in today's digital era, where the integration of technology in learning is key to improving the quality and effectiveness of education. The practicality of the PETANI application also opens up opportunities for replication and adaptation in various other regions with similar characteristics, allowing its potential impact to be widespread in efforts to improve children's quality of life and prevent stunting nationally. The evaluation stage is the final stage of the PETANI application development research series. The evaluation process used in this research encompasses both summative and formative evaluations. The explanation of each evaluation is as follows.

Formative evaluation

Formative evaluation was carried out during the research process. The results of the formative evaluation in this study were obtained based on the improvement suggestions given by the validators. The suggestions for improvement given by each validator are in Table 4.

Summative evaluation

Summative evaluation in this study was given after the product was implemented. In its implementation, the PETANI application was implemented on kindergarten teachers in Banyuwangi City. The summative evaluation results related to the use of the application received the following scores are in Table 5



Table 4. Evaluation Results of PETANI

No	Validator	Improvement Suggestions	Results
1.	Material	Introducing the stages of making rice into rice, so that children's knowledge is more comprehensive Introducing early literacy in children	Adding pictures about rice making process Add spelling according to the name of the food crop shown
2.	Media	Images displayed from barcode scans can be customized	Changing the displayed image customizes the screen

Table 5. User Test Questionnaire Results (Teacher)

No.	Indicator	Average Score	Description
1.	Suitability of Material to AUD	97,6%	Very good
2.	In-App Content	95,7%	Very good
3.	Helps Children's Understanding	96,8%	Very good
4.	Appeal of the App	98,1%	Very good

CONCLUSION

The conclusion of this study shows that the development of the AR Book "PETANI" as an innovative learning media significantly enriches efforts to introduce local food to early childhood and supports stunting prevention. Through the ADDIE development model, this AR Book was designed based on real needs in the field, validated by experts, and implemented and evaluated with PAUD teachers. The results of validation and user testing indicate that this media is highly feasible for use and capable of increasing children's interest, involvement, and understanding of local food plants relevant to their cultural and environmental context. The use of augmented reality technology in this AR Book not only makes the learning process more interactive and engaging but also enables teachers to deliver material more contextually and effectively. This finding confirms the importance of digital technology-based learning media innovation in supporting nutrition education, optimizing local food potential, and laying the foundation for children's health from an early age as part of the national strategy to prevent stunting.

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