

Research Article

Implementation of the Addie Model in the Development of Quartet Game in Understanding Food Security Issues for Children Aged Nine Years and Over

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Abstract.

Food waste is an issue of food security globally that includes crop failure, losses during distribution and storage or food loss, food substitutes for rice, causing nutritional deficiency problems. As part of a modern society that tends to behave consumptively, we must understand food issues so that we are wiser in buying, consuming, and disposing of leftover food. The quartet game with the theme of food security is an educational tool for children aged nine years and over, consisting of 12 themes designed based on the ADDIE Model. This study develops a card quartet for children on the ADDIE (analysis, design development, implementation, and evaluation) model that would help students to understand the food security. Based on research and development (R&D) with the ADDIE model. The intervention study was conducted in a junior high school with 30 students as respondents. The analysis stage includes problems and content. The design stage begins with observing the product and literature and creating a layout design pattern. The development stage is the validation stage with material and media experts. The implementation phase was a trial of playing the quartet game with junior high school students. The evaluation stage is the feedback received from the respondents, and there is an increase in knowledge. Thus, the ADDIE model can be used to develop the quartet of food security issues, and it can be used as an alternative to learning food security issues for children aged 12.

Keywords: food security, quartet, educational game, ADDIE Model, students

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1. Introduction

From 2020 to 2030, the demographic figures for Indonesia's population are predicted to experience an increase in the demographic bonus [1]. Population growth accompanied by excessive consumption patterns is one of the biggest triggers for the nutritional crisis and the depletion of food supplies. Among the consumer behaviors resulting from extreme consumption patterns are: (1) Consumers buy food or food ingredients

excessively, uncontrollably, or wastefully; (2) In the process of processing food, consumers or producers throw away excess food waste (then what should still be left). Can be eaten or used), (3) The number of food portions is excessive, wasting a lot of leftover food. As mentioned above, poor consumption patterns will ultimately lead to the generation of unprocessed waste (food loss) and the age of processed waste (food waste), which increasingly accumulate and increase in number every year as the population grows. Indonesia is ranked second in terms of food waste accumulation [2].

The amount of loss in Indonesia due to food loss and waste (FLW) is estimated to reach 115-184 kg/capita/year, where one-third of the total food production in Indonesia is lost to waste, and this amount should be able to meet the nutritional value of 61 to 125 million people. Indonesia, or the equivalent of 213-551 trillion rupiah/year [3]. Food Loss includes shrunken grains of rice or vegetables and rotten meat before being cooked. Meanwhile, examples of processed Food Waste include fried chicken that has only been half eaten and then thrown away, rice, and leftover food supplies that have not been finished. Indonesia produced 21,872,092.95 tons of waste per year in 2021 and is expected to continue to increase along with population growth [4] [5]. Furthermore, this waste generation also has the potential to produce carbon and methane gas, which impacts climate change through greenhouse gas emissions (equivalent to 4.4 gigatons of greenhouse gas emissions); this is also felt by farmers who experience shrinking harvests [3]. Based on this description, excessive consumption patterns are not only the cause of decreasing food supplies but also increasing waste produced by society and triggering climate change.

Food security is one of the problems in Indonesia that must be faced and resolved. The global hunger index in Indonesia in the 2017 International Food Policy Research Institute data shows that Indonesia is in the wrong category for food security [6]. The government's role is to continue to increase food security capacity through policies and programs for the community [7]. Providing solutions for food security involves many sectors to address problems of production, nutrition, health, and food availability [8].

The government has carried out socialization to the public regarding the severe impacts of excessive consumption patterns through the National Food Agency. One of the main objectives of this institution is to increase the availability of food reserves sourced from domestic production. To ensure the availability of food reserves in society, awareness is needed in consuming food wisely because the largest generation of FLW is caused by community consumption factors or food waste [3]. The coaching efforts carried out by the National Food Agency to educate the public to consume food wisely are carried out through outreach through the publication of picture storybooks

for children, outreach to various agencies, organizing educational events in multiple regions for general and family segmentation, as well as making videos on the YouTube channel, and publishing infographics on Instagram for young people.

If we look at electronic data, one of the obstacles in carrying out outreach through literacy channels may be influenced by the low interest in reading among Indonesians. This refers to data from the United Nations Educational, Scientific and Cultural Organization (UNESCO); it is said that Indonesia only ranks second to the bottom of the global society's reading interest series, namely only 0.0001% [9] strengthened in (warnasurabaya.net:2021). Thus, educational games can act as a medium for socialization, apart from via verbal (literacy) and visual (video or infographics) channels on social media, as has been done by the National Food Agency.

The use of media in learning has an important role in creating an effective learning process. The quartet card game has been studied and used in various educational contexts to enhance learning outcomes. If targeting children and teenagers, educational games using quartet cards are nothing new; based on research, it is known that quartets have been widely used in various countries [10]. In Indonesia, one of them is applied research from Surabaya State University lecturers who use quartets to introduce the culture of the people of East Java [11]. Quartet games can be used for ages starting from elementary school. In Japan, quartet games are used to introduce radiation to elementary school students and have proven effective in increasing knowledge [10]. The quartet game is played in a group of at least two people. The quartet theme is adapted to information needs; each of the four cards has the same theme. Apart from being a medium of information, the quartet is also expected to foster a sense of togetherness and reduce dependence on Android-based games on devices.

This research takes an audience of child players in the late stages of development (12-13 years) to teenagers. At this time, they are considered curious about the learning process, think realistically, have an interest in particular subjects, view grades as a measure of achieving school achievement, and form friendship groups. Therefore, games using quartets are considered suitable as learning tools. The target achievement of this game is to produce increased understanding and players so that they can explain food security issues, especially the impact of excessive consumption patterns.

To develop or create an quartet card game education is needed. Addie Model is a popular instructional design model that stands for analysis, design, development, implementation, and evaluation. ADDIE model provides a systematic and adaptive approach to the design and development of learning activities. Many researchers have used this ADDIE model to develop learning media such as Adobe Flash, Lectora Inspire, and

others with various learning materials [12]. Quartet-based learning development is also widely used using the ADDIE model. The development results show that the ADDIE model can be used as a model in card development for various purposes, such as determining the suitability of the media [13] [14], skill or behavior [15] [16], knowledge [10] [16] [17], self-efficacy [17], attitude [16]. Learning that is carried out effectively using quartet media makes students more active and critical. Media for learning food security issues for students has not been widely developed in Indonesia. It is hoped that the application of the quartet card to the issue of food security will become a medium that is easy to use and widely disseminated. Based on the background description above, researchers are interested in conducting research and developing educational quartet card games on food security issues for students so as to increase their knowledge.

2. Material and Methods

In general, research into developing the quartet game as a learning medium for food security issues was carried out from March 22, 2023, and the research has been going based on Research and Development (R&D) methods. According to Sugiyono (2015), this type of research can be used to create or develop products and test their effectiveness [18], which one the procedure uses ADDIE model (analysis, design, development, implementation, and evaluation). The research strategy was data collection by filling in pre-test and post-test questionnaires and library sources from the internet. The targets for the research in the implementation and evaluation stages where in Daarul Ahibbah Middle School.

At the analysis stage, the research team identified respondents' understanding of food security. The design stage is a series of creative processes to create a quartet product, which includes layout, typeface, creation of illustrations, and application of color to be implemented in packaging and content. Design plays a significant role in the process of transmitting messages to players. Illegible typeface, inappropriate illustrations, and irregular layout can make it challenging to understand the material. The development stage is a proofing process by design practitioners (designer from Kawan Pustaka Publishing) and employee from National Food Agency, they have expert to ensure the suitability of the physical and material quality when played. This stage allows for revisions before going into print. The implementation stage is the testing stage carried out on a group of students in a particular environment based on predetermined indicators; the results become measurable study material and can be evaluated. The evaluation is the stage of assessing the results obtained in the previous implementation

stage. Evaluation is objective and becomes a benchmark for learning achievements, so from this stage, conclusions and policy considerations can be obtained if it will be carried out on an on going basis.



(a)



(b)

Figure 1: (a) Dummy, the part of series creative processes to create a quartet product. (b) Proofing quartet card by Afnidar, employee of National Food Agency.

3. Result and Discussion

3.1. Analysis Stage

The analysis stage carried out is an analysis of food security issues and content needs in problem analysis based on literature or library studies, analysis through interviews with the teachers and students. It was also based on a pre-test question and-answer questionnaire on 30 respondents from Daarul Ahibbah Islamic Middle School located in Serang, Banten. This activity was carried out before playing the quartet cards to find out how much they understood the issue of food security. In the table below, we can see that of the ten questions asked, only two were successfully answered correctly by respondents with a total of more than 15 people, namely on indicator questions 6 and 7. The question with the lowest number of respondents who answered correctly was 2, 4, and 5. So, the conclusion is that, on average, respondents do not understand food security sufficiently.

The issue of food security with the various themes above has never been socialized at this school. So, education and socialization of food security issues are important to

TABLE 1: Pretest Result.

Indicator	Thema	Correct answer (n=30)
Question number 1	food Loss definition	Nine respondents
Question number 2	Food Waste definition	Four respondents
Question number 3	Causes the crisis food	Five respondents
Question number 4	Food substitutes for rice	Four respondents
Question number 5	Food substitute for Rica (taro)	Four respondents
Question number 6	Food substitute for rieca (cassava)	22 respondents
Question number 7	Healthy eating patterns	23 respondents
Question number 8	Consequences of Food Loss and Waste	Six respondents
Question number 9	Causes of Food Waste	11 respondents
Question number 10	Food waste prevention	Nine respondents

understand from school age. Furthermore, various types of material content that will be used in making the quartet cards are also determined at the analysis stage. At this stage, 12 themes were obtained, which will be used as food security issues. Based on the information from the teachers and students that quartet game has never been used for education. Several studies on quartet games in school learning state that the results at the analysis stage are of the importance of using learning media that does not bore students. Quartet game is one of the media that is an alternative for students in understanding game-based learning material so that it is fun for students. Inadequate media use and low knowledge are the basis for the analysis phase [19].

3.2. Design Stage

Product observations were carried out in initial planning by comparing with other quartets. What is observed are the characteristics of the card to be used as a benchmark or standard for measuring products. The next stage is literature observation; the researcher determines the material for the card theme. The primary reference was from a collection of cergams published by the National Food Agency. One of the cergams observed was "I Like Bananas," and the following information was obtained:

The following table shows the card themes sourced from the book entitled "I Like Bananas."

Based on above the script, the author created design as shown in the image below; the card structure consists of a main theme, sub-themes, and picture. The font used is Hey Comic and Candy Cake, because of these fonts have pretty good readability, have a non-continuous upright structure, and the size of the letters is the same as Arial.

TABLE 2: Information in cergam “Aku Suka Pisang”.

<p>Aku Suka Pisang, Nabila Ayu, dkk. Badan Ketahanan Pangan, Kementerian Pertanian., 2020. www.bkp.pertanian.go.id, nilai fungsional dan ekonomi pangan lokal</p>	<p>Keistimewaan pisang</p>
	<p>Pisang bikin kamu kenyang. 2,5 buah pisang (117 gr) setara dengan seporsi nasi Banyak variasi atau jenis: pisang raja, ambon, muli, tanduk, musa ingens, cavendish, merah, biru, ungu. Sumber gizi dan energi Ragam olahan: pisang rebus, goreng, molen, bolen, nagasari, sale pisang, kolak pisang. Kaya serat, vitamin C, anti oksidan, zat besi untuk sirkulasi darah, tinggi kalium (baik untuk jantung), vitamin B</p>

TABLE 3: Script for description material product.

Theme	Sub Theme	Picture description
Foods to replace rice	Banana	Figure 2,5 fresh banana (117gr)
	Taro	Picture of one taro fruit (125 grams)
	Cassava	Picture of 1,5 pieces of cassava (120 gr)
	Potato	Picture of two potatoes (210 gr)
Types of Bananas	Red Banana	Picture of red banana and processed geprek
	Horn Banana	Images of horn bananas and steamed preparations
	Mossy Ambon Banana	Picture of banana ambon and processed porridge
	Muli Banana	Picture of four muli bananas

3.3. Development Stage

To test product quality, expert readers are invited to try content material (text) and design (visual) testing. The form of testing is carried out in the form of Q&A (question and answer), which can be accessed via Google form, accompanied by product attachments, which each tester can access. Material expert readers come from the National Food Agency public relations and cooperation staff. From his assessment, the comprehensive material presented was considered very good. Expert design readers come from Art Directors at advertising agencies and illustrators at the general book publisher Kawan Pustaka. From both assessments, the design presented was also considered very good.



Figure 2: Design comprehensive including theme (the position is top in card), sub theme (consist of four theme), and picture.

Regarding design, on the theme and sub-theme of the card entitled Causes of the Food Crisis, do you think it feels good and communicative?

Regarding design, do you think it feels good and communicative on the theme and sub-theme of the Wasted Food card?

Regarding design, on the theme and sub-theme of the card entitled Food Substitutes for Rice, do you think it feels good and communicative?

1. Regarding design, on the theme and sub-theme of the card entitled Causes of the Food Crisis, do you think it feels good and communicative?
2. Regarding design, do you think it feels good and communicative on the theme and sub-theme of the Wasted Food card?
3. Regarding design, on the theme and sub-theme of the card entitled Food Substitutes for Rice, do you think it feels good and communicative?

Figure 3: Example questions for expert readers.

The next step is printing product design with packaging in 1:1 size. The team agreed to make five sample product using 180-gram art paper.



Figure 4: Printing product with packaging design.

3.4. Implementation Stage

The test was carried out on September 4, 2023, on 30 female students in Daarul Ahibbah Middle School, Serang, Banten. The students who had previously been taught how to play a quartet by the facilitators. The game period is 60 minutes and a maximum of 90 minutes.



Figure 5: Implementation stage.

Each card tested contains the following themes:

TABLE 4: Theme in quartet game.

No	Thema	Sub-theme	Description
1	Food loss	Definition	Waste that comes from food is wasted and not processed
		Stored for a long time	
		Loss on the way	
		Rotten, unsold	
2	Food Waste	Definition	Consumable food that has been processed and wasted becomes waste
		Only eat what you like	
		Eat excess leftovers	
		Purchased and not consumed	
3	Causes of crisis food	Agriculture land conservation	
		Climate change	
		Food distribution is uneven	
		Food Loss and Waste	
4	Substitute of rice	Banana	Weighing 117 grams = a portion of rice
		Taro	Weighing 125 grams = a portion of rice
		Cassava	Weighing 120 grams = a portion of rice
		Potato	Weighing 210 grams = a portion of rice
5	the uniqueness of taro	The leaves are made into vegetables	
		Become an ornamental plant	
		Tuber color varies	
		Healthy body	Taro potassium for the heart, taro calcium for the bones
6	Processed cassava that makes you full	Cassava sawut	
		Boiled Cassava	Substitute for rice for people living with diabetes or diet menus.
		Comro-misro	
		Cassava compote	
7	Healthy eating pattern	Want to eat vegetables	
		Schedule a replacement for rice	
		Avoid double carbs	Double carbohydrates cause drowsiness, difficulty thinking, and weight gain.
		Reduce sweet snacks with preservatives	

TABLE 4: Theme in quartet game.

No	Thema	Sub-theme	Description
8	Consequences of food loss and waste	Trigger food scarcity	
		Triggers disease	Typhus, dengue fever, skin diseases, and itching. Garbage accumulates containing germs, viruses, and parasites. A breeding place for mosquitoes, flies, cockroaches, and mice.
		Waste money on shopping	
		Trigger global warming	Piles of rubbish produce methane and CO2 gas > Methane and CO2 gas destroys the ozone layer > Sunlight enters without an ozone filter, causing global warming.
9	The Prevent of Food Loss and Waste	1. Shop wisely for food	
		Eat enough and finish it	
		Share more appropriate food	
		Sorting food waste and turning it into fertilizer	Composters produce solid and liquid fertilizer. Use kitchen waste such as leftover vegetables, fruit, bread, and rice. Use brown materials such as tree branches, dry leaves, cardboard chips, and paper.
10	Food loss and waste	Rupiah value	The value of wasted food in Indonesia during 2000-2019 reached 213-551 trillion rupiah.
		Hungry people	The value of wasted food during 2000-2019 could provide nutrition for 61-125 million hungry people.
		Rice and vegetable	Much of the wasted food comes from rice and vegetables.
		African elephant	1.3 billion tons of world food is wasted annually, equivalent to 260 million African elephants weighing 5000 kg.

3.5. Evaluation Stage

In general, there was an increase in results except for indicator question number 3 regarding the causes of the food crisis, which decreased by one respondent. Meanwhile, indicators number 1 (food loss) and number 2 (food waste) are among the categories that show the highest increase compared to other types.

TABLE 5: Post-test Result.

Indicator	Theme	Correct answer pre-test results	Correct answer post-test results	Delta
Quest. no 1	Food loss definition	9 respondents	23 respondents	Up 14 respondents
Quest. no 2	Food waste definition	4 respondents	15 respondents	Up 11 respondents
Quest. no 3	Causes the crisis food	5 respondents	4 respondents	Down one respondent
Quest. no 4	Food substitutes for rice	4 respondents	13 respondents	up nine respondents
Quest. no 5	Food substitute for rice (taro)	4 respondents	9 respondents	Up five respondents
Quest. no 6	Food substitute for rice (cassava)	22 respondents	26 respondents	Up four respondents
Quest. no 7	Healthy eating patterns	23 respondents	24 respondents	Up one responded
Quest. no 8	Consequences of food loss and waste	6 respondents	10 respondents	Up four respondents
Quest. no 9	Causes of food waste	11 respondents	13 respondents	Up two respondents
Quest. no 10	Food waste prevention	9 respondents	12 respondents	Up three respondents

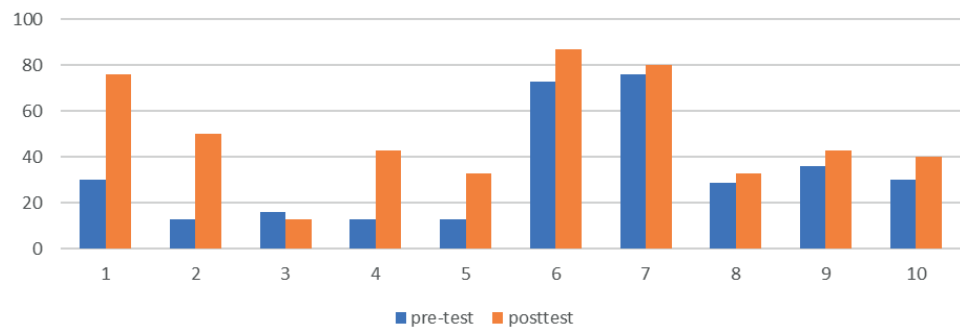


Figure 6: Summative evaluation of food security quartet education.

Of the 30 respondents, 23 experienced an increase in understanding, while four experienced a decrease, and the remaining three were in the same position. However, by looking at the number of additions, the highest rate of increase was a difference of 30 by seven respondents, a difference of 20 and 10 by six respondents, a difference of 40 by three respondents, and only one person with an increased rate of 60, it can be concluded that the rate of personal improvement is at a low level.

TABLE 6: Evaluation of personal values.

No	The result of test	The development of test	Delta	Quantities
1	30	20	-10	4
2	20	10	-10	
3	30	20	-10	
4	30	20	-10	
5	50	50	0	3
6	60	60	0	
7	50	50	0	
8	0	10	10	6
9	50	60	10	
10	40	50	10	
11	20	30	10	
12	30	40	10	
13	10	20	10	
14	40	60	20	6
15	20	40	20	
16	30	50	20	
17	30	50	20	
18	40	60	20	
19	40	60	20	
20	50	80	30	7
21	20	50	30	
22	40	70	30	
23	20	50	30	
24	20	50	30	
25	20	50	30	
26	20	50	30	
27	30	70	40	3
28	40	80	40	
29	50	90	40	
30	30	90	60	1

4. Conclusion

The quartet’s development as a learning medium for food security issues has successfully used the ADDIE model. Various factors influence the implementation stage. Externally, a conducive environmental atmosphere, sufficient playing time, and clear directions from the facilitator also influence success. Meanwhile, the respondent’s mood and mentality also affect the success of internal factors.

As a recommendation, before testing, it is hoped that the research team will already know the environmental conditions and atmosphere of the place to be tested. Suppose the environment is influenced by noise and bustle from the activities of other students who are not used as respondents. In that case, the effectiveness of using quartets will likely decrease. Determining the right time for the implementation is also essential so that researchers and facilitators can prepare the conditions for their respondents to appear in the best state. Sometimes, due to ignorance, when the test is carried out, it turns out that the respondent is still tied up with many unfinished school assignments and exams. This condition makes it difficult for them to concentrate and affects them emotionally. Don't forget to give a reward or form of thanks for their willingness to participate in the test. Kind words and motivation are also provided to them, especially for those who collect the fewest cards. For the research team, a proofreader from a linguist is needed to ensure that the language used in the quartet cards can be understood well by respondents. Always confirm they can ask the facilitator if they don't understand anything.

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